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ABSTRACT

Increasing awareness of environmental issues and the implementation of environmental programs have spurred the need for education and training for sustainable development in many countries. Analytical concepts and practical tools necessary for formulating environmental training policies are discussed. Also, major education and training issues raised in "Agenda 21," the Plan of Action adopted by the United Nations Conference on Environment and Development are addressed. Policy for three major types of environmental training are discussed including environmental literacy training for the general public, job-related environmental literacy training, and environmental training for people engaged in environmental protection jobs. Five parts cover the topics of: (1) environmental policies and training; (2) environmental training policy; (3) the salient characteristics of environmental training; (4) environmental training: institutional strategies and methods; and (5) training for major actors in the environmental area. A bibliography contains 54 references, and an annex contains a report on a meeting held to examine the draft final report "Environmental Training: Policy and Practice." (LZ)

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ENVIRONMENTAL TRAINING

POLICY AND PRACTICE FOR SUSTAINABLE DEVELOPMENT

Raúl Gagliardi
Torkel Alfthan

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Raúl Gagliardi and Torkel Alfthan

INTERNATIONAL LABOUR OFFICE GENEVA

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Preface

Increasing awareness of environmental issues and the implementation of environmental programmes have spurred the need for environmental training in many countries.

The ILO has a mandate to improve the working conditions of workers everywhere. Education and training are major instruments in this task. It is now also increasingly recognized that environmental skills, knowledge and training should be part and parcel of training for employment.

The present book is about environmental training policy. It provides the analytical concepts and practical tools necessary for formulating environmental training policies. It addresses the major education and training issues raised in *Agenda 21*, the Plan of Action adopted by the United Nations Conference on Environment and Development (UNCED), which took place in Rio de Janeiro, Brazil in June 1992.

In 1989 the ILO's Training Policies Branch prepared a Background Report for a Tripartite Meeting on Employment and Training Implications of Environmental Policies in Europe. It was decided to build on the experience gained in the environmental training area and an agreement was reached with the Ministry of Education and Science of the Federal Republic of Germany to finance a research project on the subject. This book is a follow-up to the final Report prepared for this project. The findings contained in the book were examined and supported by an informal Expert Meeting organized by the Training Policies Branch in Geneva, May 1993.

The authors would like to thank the donor for generous support in making it possible to undertake the project in this new and challenging area. They also express their gratitude to the experts who prepared country reports. The civil servants, decision-makers, managers, researchers, students, and trainers working in environmental agencies, enterprises, schools and training institutions, government ministries and international governmental and non-governmental organizations are also thanked for their contributions. Finally the authors' thanks go to the participants in the informal Expert Meeting that reviewed a draft Report of the project.

Raúl Gagliardi *Torkel Alfthan*

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Executive summary

Environmental protection and sustainable patterns of development demand co-ordinated environmental policies at the local, national and international levels. As every human activity affects the environment, the entire population needs to be mobilized, educated and trained to protect the environment. Environmental training policy is an integral part of environmental and sustainable development policies.

The first step in formulating environmental training policy is to encourage a debate about what should constitute a desirable environment. This debate should involve all strata in society: political parties, industrialists and trade unions, environmental pressure groups, local community organizations and concerned individual citizens. An open, participatory debate about the environment is most likely to promote *preventive* environmental policies that attack pollution and environmental degradation at their source and encourage firms and people to introduce clean technologies and sustainable production and consumption practises.

Preventive environmental policies: new training needs

In place of narrow specialists who design and operate pollution abating equipment – the corrective, end-of-the-pipe approach – preventive policies will demand a massive expansion of environmental education and training at three levels.

First, *all* people must become *environmentally literate*. Environmental literacy education to promote new values, ethics and behaviour that are compatible with a sustainable environment should take place wherever a learning process goes on, be it at home, at school or at work. **Second**, job related environmental literacy training should be integrated into on-and off-the-job training, retraining and continuous training programmes. The task is to foster an environmental quality culture among workers. Staff who are committed to environmental excellence and have the motivation and skills to improve products, production practices and individual work performance are increasingly

regarded as competitive trump cards by many enterprises. **Third**, policy makers need environmental skills, knowledge and training that enable them to base their decisions on sound environmental criteria. Environmental supervision, monitoring and advisory work requires trained professionals. Some jobs are not new, like those in existing utilities like water treatment and waste disposal. For the new activities, occupational and skill profiles need to be defined and training programmes organized. Enterprise staff need training to ensure that the company meets emission standards and environmental regulations. Staff or outside consultants need training to equip them to prepare environmental audits.

Environmental training: some salient characteristics

Environmental education and training will cover a large number of people, jobs and occupations. Identifying some common characteristics of such programmes will facilitate their design and implementation. Environmental training should be *multidisciplinary*, helping the learner to understand complex systems and their elements, the causes and effects of environmental phenomena and their interaction with human activities.

As environmental policy is shifting from correcting and controlling pollution towards making economic activity sustainable, producers and consumers alike will need to change their attitudes and practices. Ultimately a new *environmental ethic* will have to induce changes in people's life styles. Purposeful environmental education and training can greatly promote the new environmental ethic. By emphasizing popular participation, collective action, local and international solidarity and negotiated resolution of contentious environmental issues, training programmes can be instrumental in developing an environmental ethic among vast sections of society: individuals, companies, the social partners and other interest groups.

Major infrastructural and environmental protection measures bring conflicts of interest in their wake. Environmental training can contribute to *managing environmental conflicts* equitably. Training empowers managers, trade unions, citizen groups and individuals to defend their interests. They learn to understand the economic, social and environmental issues at stake, to appreciate the interests and viewpoints of other people and groups around the negotiating table and to respect the democratic negotiating process as a method to resolve conflicts.

Institutional strategies and training methods

If environmental education and training is to reach everybody, it should be given through different institutions, such as schools, enterprises, community organizations, trade unions and the mass media. Each institution can focus on those areas where it has a comparative advantage. The broadest audience belongs to the mass media, which can inform the public about environmental issues and ways of solving environmental problems. Schools are in a good position to instill basic scientific concepts. Training institutions can develop occupation-specific environmental knowledge and skills. Enterprises are best equipped to provide environmental training tailored to the job. The natural clientele of trade unions are their members. Community organizations and NGOs, often active at the grassroots level, can educate members of the community, in particular women and informal sector workers. Finally, universities and other higher education and training institutions have the task of training environmental professionals.

Some *education and training methods* have a good track record in conveying environmental knowledge and skills. Methods that are learner oriented and maintain close contact with the actual environment have proven highly effective in overcoming cognitive and affective difficulties of the learner. They tend to use problem solving techniques, stimulate individual initiative and creativity, emphasize participation and teamwork and promote curiosity about the environment. Research and experience has also shown that training based on learning a few environmental concepts – *structurant concepts* – helps learners to overcome their learning difficulties and provides a basis for further learning.

A *territorial approach* to environmental training has proven an effective training method. It encourages an understanding of the environmental, economic, social and cultural aspects of the territory and its resources, and the environmental impact of using them. It also helps learners to identify and implement solutions to environmental problems.

Another effective method is the community approach to environmental training. The trainer can exploit those community based concepts, knowledge and beliefs which facilitate learning, while at the same time helping the learner to abandon unscientific beliefs. In Malaysia, for example, religious beliefs were

used in a successful educational campaign to promote rat control in farming communities.

Training for major actors in the environmental area

Some target groups for environmental training are more important than others. Major actors on the environment are enterprise management and staff, policy makers, farmers, trainers, women and informal sector workers.

The Indonesian national Integrated Pest Management Programme offers a good example of innovative, targeted training for a major environmental actor: the farming community. The programme has trained over 400,000 farmers to control and reduce their use of environmentally damaging pesticides, making them experts in their own fields. The farmers produce healthy rice crops by conserving the natural enemies of pest insects, mostly wasps and spiders, and monitoring their fields weekly. The programme conveys scientific findings to often poorly educated farmers by using simple language and a community-based, on-the-job training approach. The benefits are increased output, savings on pesticides, and improved incomes. Further benefits are environmental sustainability, reduced levels of pesticides in farm produce, and improved health among farmers and consumers of farm produce.

Introduction

Ecological disasters, such as desertification, the disappearance of species, eutrophication[1] of lakes and soil degradation are jeopardizing the livelihood of millions of people. In many regions the air is highly polluted, leading to widespread respiratory disease. Water may be altogether lacking or so contaminated that it becomes a breeding ground for infectious diseases. Accumulation of waste and inadequate waste treatment and disposal mean that many urban areas are infested with rats and other vermin, with health and sanitary conditions generally worsening. Human activities are causing what may be irreversible damage to the environment. At the end of the twentieth century, *reversing environmental degradation* and *reducing global inequalities* are perhaps the greatest challenges facing the human race. Efforts to realize these goals are mutually supportive and the foundation of sustainable development. This book focuses on the first goal.

The solutions to environmental problems are difficult to identify and implement owing to the intricate relationships that prevail between environmental systems and human activities. Environmental protection measures implemented in isolation may be ineffective in improving the environment and may even have a negative impact. Having a public transport system, for example, is not in itself sufficient to reduce the chemical pollution caused by the extensive use of private cars. The promotion of public transport must be accompanied by other supportive measures. Public transport must be made a sufficiently attractive alternative to the private car. People need to be encouraged to actually use it. Parking facilities need to be constructed in strategic sites. If a *synergy* between various environmental protection measures is to be developed, such measures must be part of a coherent programme that identifies priorities, allocates budgets, manpower and skills, and evaluates the effectiveness of the measures implemented.

The Plan of Action – *Agenda 21* – adopted by the United Nations Conference on Environment and Development (Rio de Janeiro, June 1992),

[1] "Eutrophication" means the excessive growth of water flora caused by, for example, the supply of fertilizer used in agriculture. This growth leads to lack of oxygen and the degradation of lakes and other water systems.

addresses these crucial issues. As the preamble states: "Agenda 21 addresses the pressing problems of today and also aims at preparing the world for the challenges at the highest level on development and environment cooperation. Its successful implementation is first and foremost the responsibility of Governments. National strategies, plans, policies and processes are crucial in achieving this. International cooperation should support and supplement such national efforts. In this context, the United Nations system has a key role to play. Other international, regional and sub-regional organisations are also called upon to contribute to this effort. The broadest public participation and the active involvement of the non-governmental organisations and other groups should also be encouraged".

Chapter 36 of *Agenda 21*, "Promoting education, public awareness and training" stresses the importance of environmental training, to be carried out by governments, education and training institutions, industry, employers' and workers' organizations, etc.: "Training is one of the most important tools to develop human resources and facilitate the transition to a more sustainable world. It should have a job-specific focus, aimed at filling gaps in knowledge and skill that would help individuals find employment and be involved in environmental and development work. At the same time, training programmes should promote a greater awareness of environment and development issues as a two-way learning process".

Agenda 21 calls for:

- vocational training programmes "that meet the needs of environment and development with ensured access to training opportunities, regardless of social status, age, gender, race or religion";
- the promotion of a "flexible and adaptable workforce of various ages equipped to meet growing environment and development problems and changes arising from the transition to a sustainable society";
- the strengthening of national capacities, "particularly in scientific education and training", and efforts "to facilitate the transfer and assimilation of new environmentally sound, socially acceptable and appropriate technology and know-how";
- an integration of environmental and human ecological considerations "at all managerial levels and in all functional management areas, such as marketing, production and finance".

The issues

This book is about environmental training policy. It addresses the major training issues raised in *Agenda 21*. It attempts to provide the analytical concepts and practical tools necessary for the formulation of environmental training policy.

Why was this research undertaken? There are several reasons. Environmental protection is a new activity that demands co-ordinated environmental policies at the local, national and international levels. As every human activity affects the environment, the entire population needs to be mobilized, and educated and trained to protect the environment. Policy formulation must take into account the fact that different population groups may have conflicting interests with respect to environmental protection measures. These interests have to be reconciled through a process of negotiation. Skilled people trained in a variety of professional disciplines are needed to undertake environmental protection work. Environmental training policy must therefore constitute an integral part of environmental policy.

As far as we know no comprehensive environmental training policy has yet been developed. There are examples of piecemeal training approaches focusing on specific environmental problems and target groups, but these tend to be isolated and uncoordinated.

Environmental protection work demands an understanding of the complex relationships between human activities and environmental systems. A major task of environmental training is to convey this understanding, which requires a unique blend of training in the "hard" and human sciences.

Finally, effective environmental protection calls for significant changes in economic and social activities in order to eliminate their adverse impact on the environment. Production technology, managerial practices and people's attitudes and behaviour need to change in order to make them compatible with a healthy and sustainable environment. Environmental training is a major tool in bringing these changes about. For all these reasons a book on environmental training policy is timely.

The book, written for environmental policy-makers and individuals and institutions that plan and organize environmental training programmes, will raise some major issues of environmental training policy and illustrates them with the help of concrete examples. These are issues that planners need to understand when designing and organizing specific training programmes.

Among other things, planners need to analyse the environmental labour market, identify the skills and competencies required in environmental protection jobs, identify the learning obstacles in environmental training, and propose ways and means of overcoming them. The book also defines what is understood by environmental training and identifies the training needs of the major actors in environmental protection. Finally, it looks at the major issues relating to training environmental trainers, the distinctive features and objectives of environmental education for the public, and environmental training for specific jobs.

The methodology

The research was undertaken in three phases. It started with research by environmental training experts into environmental policy and training issues and experiences in the following countries: Brazil, France, Germany, Hungary, Italy, Sweden, and the United States. These experts prepared country studies based on their observations of actual training programmes and discussions with students and environmental training people.

The second step comprised the preparation of a draft Report containing an overview of the major issues of training policy and practice. The draft Report also integrated the findings of the country case studies and other findings of research and practice in the environmental field.

The third step was the convening of an informal meeting of environmental training experts that reviewed the draft Report prepared under the second stage and formulated a number of observations that have been integrated into the present book.

PART I

ENVIRONMENTAL POLICIES AND TRAINING

A

The meaning of "sustainable" development

A discussion of what constitutes a sustainable environment is essential for any study on environmental training policy. It is also a subject of continuous debate at international and national levels, the outcome determining the objectives and orientation of environmental protection policies and programmes.

Some environmental organizations have as their aim a return to a "natural" environment as it was before human habitation. In most areas inhabited by human beings, however, such a return would not be possible without destroying the physical infrastructure and the social fabric. Agriculture, mining, fishing, forestry, industry, transport and construction generate great and sometimes irreversible changes in the environment. As a return to a "natural" environment is in most cases an unrealistic goal, the emphasis must be put on *sustainable* development – that is, a course of development that can be maintained indefinetely without adverse effects on the environment, thus ensuring that the planet will continue to be able to support future generations.

Agenda 21, the Plan of Action adopted by the United Nations Conference on Environment and Development in 1992, discusses the meaning of sustainability: "While managing resources sustainably, an environmental policy that focuses mainly on the conservation and protection of resources must take due account of those who depend on the resources for their livelihood... Equally, a development policy that focuses mainly on increasing the production of goods without addressing the sustainability of the resources on which production is based will sooner or later run into declining productivity, which could also have an adverse impact on poverty."[2]

According to UNESCO: "Sustainable development is more than just ecological sustainability. ... Sustainable development is not compatible with poverty nor with the absence of human rights and freedom, nor with ignorance or cultural, economic, political or ethnic exclusion. This is not only because the

[2] *Agenda 21*, Ch. 3.2.

solution to these social problems presupposes an ethical imperative, but also because these problems impede creativity, technical progress and the formation of the varieties of capital necessary for sustainable development. Thus education and training for sustainable development is not just education about the environment, though it includes it".[3]

Education and training for sustainable development should therefore be addressed to the entire population and should combine science and technology with ethics and social development.

B

International, national and local environmental policy

Adequate environmental policies must be implemented at the international, national and local levels, mobilizing public and private institutions, enterprises and individuals in the task.

International environmental policies and agreements are necessary to guide national actions and ensure their co-ordination and compatibility. A case in point is the recent Convention to protect biological diversity which was signed by 156 nations at the UN Conference on Environment and Development (Rio de Janeiro, June 1992). International aid agreements also act as catalysts for national initiatives to protect the environment and train the requisite human resources, without which any national environmental policy will be a dead letter.

National environmental policy has as its objectives the correction and prevention of environmental degradation within a country's borders and the allocation of national resources to environmental improvement and protection. Because pollution and environmental degradation have no frontiers, many countries extend their environmental policy beyond their own borders. This

[3] Luis Albala-Bertrand: *Reshaping education towards sustainable development*, Environment and development briefs, No. 4 (Paris, UNESCO).

may happen when a neighbouring country is helped to reduce its cross-border pollution. Such bilateral (and regional) agreements abound between the countries of Western Europe and the former communist countries in Central and Eastern Europe. Education and training must constitute an integral part of national environmental policy and should address equally the general public and the professionals who will be putting the policy into effect.

Local environmental policies and measures, in provinces, towns and villages, are the best means of eliminating the local causes of environmental degradation. Environmental education and training that addresses local problems and meets the specific needs of local communities is often best designed and implemented at the local level. Community associations, which often maintain excellent contacts with the local population, can motivate and mobilize people to undertake practical measures to improve the environment and can also act as educators and trainers.

Enterprises must also implement coherent environmental policies, as they often exert a great impact on the environment. Many enterprises, particularly innovative ones, deploy their environmental policy as an important competitive instrument.

C

Corrective versus preventive environmental policies: Different training needs

The immediate response by policy-makers to environmental degradation has generally been to promote *corrective environmental policies* in order to *control* pollution and environmental degradation. Polluting industries have been obliged or encouraged to install scrubbers and filters in order to control or reduce emissions of pollutants into the soil, water streams and atmosphere. This corrective technology has been installed at the end of the production line. Its effectiveness has been limited. Corrective environmental policies do not eliminate the sources of pollution and environmental degradation.

Corrective environmental policies often result in pollution and environmental hazards appearing in areas other than those which they are supposed to control. In the United States, for example, pits, ponds and lagoons were used until 1980 to contain industrial wastes and prevent them from contaminating surface water streams. Little regard was given to the serious ground water pollution that resulted. Controlling industrial pollution through filters and scrubbers also raises the problematic issue of how to dispose of these devices after use. The same argument applies to nuclear waste and other hazardous wastes generated by industrial processes. Disposal of waste, a corrective measure, is never entirely satisfactory since it *does not eliminate waste*.

Intrinsic to corrective environmental measures – and therefore a major obstacle to elevating environmental protection to a strategic priority – is the view that environmental protection is a purely technical and regulatory matter. Compliance with regulations demands better scrubbers, better filters and more paperwork. This is the end-of-the-pipe philosophy where pollution control is identified with a piece of equipment placed at the end of the manufacturing process. However, this philosophy overlooks the human factor. The three major environmental disasters in recent years – Bhopal, Chernobyl and Valdez – were all caused by human error. The technology was there but people failed to follow the correct policies and procedures. Technology and regulations do not in themselves motivate people.

Under the regime of corrective policies, it was a reasonable approach to train *specialists* in pollution control. As new equipment and production technology came on the market, new types of specialists were needed. Current programmes tend to train people largely oriented towards controlling, remedying or cleaning up environmental problems. Today most professionals are still trained to deal with a subset of environmental problems, such as air and water pollution or dealing with hazardous wastes. They are not trained holistically to approach environmental problems in an integrated way.[4]

By ignoring the multidisciplinary nature of environmental problems, this approach to education and training is ineffective in addressing the environmental challenge. In fact specialist training in pollution control is becoming less and less satisfactory as industry in many countries is moving towards prevention, that is, towards making production processes environmentally sustainable

[4] Anthony D. Cortese: "Towards environmental reponsibility: How do we become literate?", in *EPA Journal*, Sept/Oct 1991. EPA is the acronym for the US Environmental Protection Agency.

by developing new, cleaner technologies. A change of philosophy is gradually taking place, and many firms, institutions and individuals are adopting policies that anticipate and prevent pollution. Economic and industrial strategies that reduce the consumption of resources, the use of toxic substances, and the production of wastes are essential to prevent further environmental degradation and protect human health. Making industrial and other economic activity sustainable will demand that *everybody* becomes environmentally literate.

Today, the emphasis in training is therefore shifting away from pollution control training for specialists towards *environmental literacy training for everybody*. The objective is to develop attitudes, skills and know-how that are conducive to preventing pollution.

Ultimately **preventive environmental policies and programmes** that promote the introduction of clean technologies and environmentally sustainable business and industrial practices are the only effective solution. Lead poisoning, for example, can only be eliminated by removing lead from petrol. As the Science Advisory Board of the US Environmental Protection Agency observes in a recent report, **Reducing Risk**, every possible tool should be mobilized to change the behaviour of individuals and institutions. Table 1 illustrates the differences at enterprise level between corrective and preventive policies.

Table 1: The enterprise: corrective and preventive environment policies

Corrective policies	Preventive policies
• Using filters to reduce air, water and soil pollution	• Reducing raw material and energy inputs
• Organising waste disposal and treatment	• Designing new products to facilitate recycling
• Incinerating	• Reducing waste and polluants
• Dumping	• Designing new packages
• Land filling	• Reducing paper, ink, aluminium, glass, etc.
• Clean-up operations	• Designing packaging that can be recycled
	• Organising waste disposal for recycling
	• Analysing the effects of pollutants on all environmental systems (eco-systems, air, soil, water, urban areas, rural areas, etc.)

D

Promoting preventive environmental policies

Tools to promote preventive environmental policies and measures and *environmental responsibility* include: environmental taxes, market incentives, technology transfer, technical assistance, the dissemination of environmental information, and education and training. A brief review of how some of these tools can be used to promote preventive environmental policies is given below.

1. Environmental taxes and market incentives

By following the principle that the *polluter should pay*, governments can tax enterprises, institutions and individuals who pollute the environment, or introduce pollution fees. There are many tools at their disposal. Households can be charged for the amount of waste they generate, for example by rubbish collectors only accepting rubbish put in special, highly priced rubbish bags. Governments can tax the consumption of carbon dioxide, say by taxing the petrol used in cars, to encourage energy-saving and the reduction of greenhouse gas emissions. Utility companies can offer energy subscribers rate reductions if they introduce energy-saving devices. Governments can institute tradeable pollution permits, which allow firms emissions of toxic substances up to a certain threshold. By reducing their emissions through better production practices and investments in new, clean technology, firms can sell their surplus permits to other companies that need them in order to be able to continue production. These permits thus act as an incentive for firms to introduce more environmentally sound production technology and practices.

Governments can reduce the price subsidies that benefit farmers. Lower prices would discourage surplus production, which exacerbates the pollution of land and water. Although some of the recent increase in agricultural production in OECD (Organization for Economic Co-operation and Development) countries has come from additional land (usually from ploughing valuable

European grassland and North American wetlands), most of it has come from increasingly intensive forms of cultivation, using large amounts of fertilizer and pesticide.

2. Technology transfer and technical assistance

Although there may be exceptions, older generations of industrial infrastructure and technology are generally dirtier, more polluting and more energy-intensive per unit of output than newer technology. Today, much of the thrust in technological innovation in the advanced industrial economies is geared to improving energy efficiency and reducing raw material inputs in production while increasing capital and labour productivity. Not surprisingly, the energy Japan now consumes per unit of national output is the lowest in the world.[5] In some countries, in particular Germany, Japan, Sweden and the United States, industries that produce new, environmentally benign production technology are important growth sectors.

At the same time, governments in former communist countries are growing more conscious of the environmental degradation caused by their dirty coal, antiquated factories, profligate dumping of waste, hazardous nuclear plants and ill-conceived development plans. They need technical assistance and new technology to help them lessen the damage. There is enormous scope for integrating technology transfer and technical assistance into aid packages for those countries.[6] Some companies have already engaged – often in partnership with international financial and donor institutions – in programmes to transfer their production, energy-generating, transport and distribution technologies to less technologically advanced countries with severe environmental problems. Examples are Finnish and Swedish manufacturing and utility companies, which provide technology, technical know-how and training to their counterpart companies in the Baltic States. The technology transfer helps the latter companies modernize their production infrastructure and introduce more environmentally sustainable production practices.

But there is also intensive technology transfer taking place at the local and regional levels. One example is the transfer between developers/producers

[5] "Japan finds a cause", in *The World in 1993* (London, Economist Publications 1992).

[6] "The green agenda, '93", in *The World in 1993*, ibid.

of environmentally sustainable technologies and the consumers of these technologies. Take the case of some large utility companies in the United States. Southern California Edison (Los Angeles area) and Pacific Gas and Electric (San Francisco) not only promote their own technology but also encourage, through research and development and financial assistance, independent manufacturing companies to improve the energy efficiency of the equipment they manufacture. In addition, the utility companies use several instruments to encourage their industrial, commercial and residential customers to replace obsolete equipment and appliances with energy-efficient substitutes. The means include demonstration, technical advice and training. Both companies have large demonstration facilities exhibiting state-of-the-art energy-saving technology, developed both by themselves and by other companies.

3. Dissemination of information

Fundamental to effective preventive environmental policies is the dissemination of information about the sources of pollution.

In the United States, the *community right to know principle*, enacted by law, is built around the Toxics Release Inventory (TRI), which measures emissions of over 300 toxic chemicals by manufacturing facilities throughout the country. The TRI does not force companies to reduce emissions of any kind, but it does require them to make current emission levels public. This information enters into the public domain and is available to everybody, including shareholders in the company, neighbours, newspapers and members of Congress. Such information gives citizen groups and environmental organizations a powerful tool with which to put pressure on bad environmental performers to clean up their act. On the other hand, a firm pursuing enlightened environmental practices can exploit this information to enhance its "green" image among competitors and customers. To the same end, enterprises can also develop their *environmental auditing activity* and disseminate the information to shareholders.

When William Reilly, former Administrator of the US Environmental Protection Agency, was asked how countries with massive environmental needs and few resources can tackle their problems, his answer was:

"Start with the disclosure of emissions. Require that the data be published in local newspapers. Then support a healthy NGO movement. At that point, a fascinating dynamic begins to occur. The community interacts with plant

managers and workers and government to bring down pollution levels. Such is the power of information".[7]

Ultimately, an informed public appears to be the best guarantor of environmentally sustainable policies, the objective of providing information about the environment being to *empower* people to take appropriate action. Environmental education and training are important channels through which such information can be disseminated.

4. Education and training

The distinction between corrective and preventive environmental policies is crucial for the formulation of environmental training policies. The former call for specialists to design and maintain the requisite corrective end-of-the-pipe technology. The latter demand training that promotes environmental literacy for *everybody* and touches upon often intangible matters, such as the development of a company culture and total quality philosophy, the motivation of employees, and the promotion of environmentally sustainable company practices. Such training encompasses educating the general public to change their economic, social and individual behaviour in respect of the environment. Finally it incorporates the training of professionals who can undertake multidisciplinary environmental work in environmental agencies and companies. The following chapter, which looks at environmental training policy, covers these various types of environmental education and training.

[7] William K. Reilly: *"The power of information"*, Keynote address given at the Second Annual Corporate Quality/Environmental Management Conference, organised by Global Environmental Management Initiative (GEMI), 16-18 March 1992, Arlington, Virginia.

PART II

ENVIRONMENTAL TRAINING POLICY

Environmental training policy is a comprehensive concept covering a number of elements. These include, inter alia:

- identifying training objectives;
- determining environmental training priorities;
- matching training programmes to enterprises' demand for environmental knowledge and skills;
- determining the contents of training programmes;
- identifying the best modes and methods of training;
- selecting the target audiences for training;
- ensuring the financing of training activities.

Some training policy elements, such as the financing of training, are common to all training programmes, and do not need particular treatment here. With regard to some other elements, environmental training exhibits particular features that deserve attention. A case in point is the objectives of environmental training. This chapter will focus on some macro aspects of environmental training policy, namely the objectives of environmental training, labour market issues, and the cultural context of environmental training. The micro aspects of environmental training policy, for example determining the content of training programmes and selecting the modes and methods of training, will be covered in Chapters 3 and 4.

A

The objectives of environmental training

Three major types of environmental training can be singled out, each of which has its own specific objectives. They are:

- environmental literacy training for the general public;
- job-related environmental literacy training;
- environmental training for people engaged in environmental protection jobs.

1. Environmental literacy training for the general public

All human activities have some sort of impact on the environment. Everyone should therefore possess a basic understanding of environmental processes and of the effects that production and consumption activities have on the environment. Education and training to convey this understanding will *not* prepare people for employment in environmental protection jobs. The objectives are rather to teach individuals to respect the environment, to raise their awareness of environmental issues, and to empower to them to take individual and collective action to protect the environment or to put pressure on the responsible authorities to take action. By promoting new environmental values and behaviour – an environmental ethic – environmental literacy training is an essential element in any effort to promote sustainable development practices.

In addition to contributing to more sustainable production and consumption practices, environmental literacy training has additional, highly beneficial effects on the quality of life of individuals, their families and the community at large. It can contribute to improving living and working conditions, sanitation, nutritional habits, and health. Take the example of blindness cased by lack of vitamin A in many developing countries. This disease can easily be remedied – and the quality of life of hundreds of thousands of people improved – by providing basic training in preparing food based on certain plants that contain the missing vitamin. Pollution in the home, which leads to eye disease among women in many developing countries, can be eliminated by installing simple chimneys and by encouraging households to use solar cookers. Many of the physical and mental factors that reduce the quality of everyday life – excessive noise, air and water pollution, toxic wastes, etc. – can be reduced or eliminated altogether by providing people, through environmental literacy training, with the conceptual, analytical and practical tools to tackle the problems.

Basic environmental literacy training that reaches the general public is likely to have other positive effects as well. These include enhancing individuals' ability to base their consumption behaviour on sound environmental criteria. Raising environmental awareness among future workers can help prepare the ground for enterprise-based environmental protection programmes. Such training is also likely to facilitate communication about environmental issues and problems and the search for solutions by government, the social partners and local communities.

The illustrations of basic environmental literacy training that follow are just a few examples among the myriad of projects and programmes run by public authorities, schools, NGOs, enterprises, etc., which have sprung up, either on the initiative of governments or through local initiative. They have taken place in highly different circumstances in response to different needs and priorites. Although they differ in nature, they all have in common an endeavour to mobilize local resources and expertise to solve specific problems affecting the surrounding community. We also highlight some of the lessons that can be drawn from these examples and the difficulties that have to be tackled when designing environmental literacy programmes. Finally, we suggest a conceptual model for designing such programmes.

a. Environmental education in schools

A large proportion of the world's children – in many countries *all* children – go through the education system. Schools are therefore a potentially important medium for developing environmental literacy among tomorrow's workers and decision-makers. However, evaluations that have been undertaken suggest that at the end of compulsory schooling most young people lack the necessary knowledge and conceptual and logical ability to understand environmental phenomena. For example, they do not understand the structure and dynamics of ecosystems nor the links between the environment and human activities. Experience shows that many school leavers lack the motivation to change their behaviour and reduce the adverse environmental impact of their daily activities. Many projects and programmes have been put into effect to attempt to tackle these shortcomings, with varying success.

The following examples all represent serious attempts to use the school system as a medium for instilling environmental literacy. They suggest that any environmental education programme, in order to be effective, must establish a purposeful link between educational objectives and methods, on the one hand, and the needs of individuals and communities to protect their environment, on the other. These programmes have managed to establish that link, but many environmental literacy and education programmes have failed to do so.

Belgium: Environmental education in secondary schools

When encouraged to demonstrate real responsibility for the environment, both within the school and in their immediate surroundings, students in some

Belgian secondary schools have undertaken a number of environmental protection activities including:

- monitoring water quality in their neighbourhood;
- communicating the measured results; and the amounts by which certain elements exceeded permitted levels, to local and national mass media;
- organizing an exhibition on the theme of "the quest for and the conquest of water".

This environmental education programme, responding to growing awareness about water pollution in the Namur region, was triggered by the local Lions Club and financed by the Fonds de l'Environnement de la Fondation Roi Baudouin.[8]

Quebec, Canada: "Together, let's salvage our planet"

This programme for primary and secondary schools is supported by several institutions, including a recycling association, various educational associations and the province's Ministry of Environment. Educational kits have been distributed free to teachers, school directors, parents and interested groups.[9]

Four educational tools are used in the programme: an educational kit or folder, a tape of a song and a videotape on environmental themes, and theatrical performances in the province's schools which sensitize students to environmental issues. The educational kit focuses on six themes: artistic creations; consumption habits and their environmental impact; product recycling; the environment and the quality of life; the environment of indigenous peoples; and peace, development and the environment. Students undertake practical work in 37 projects, each involving the identification and analysis of problems and the search for solutions. The kit, intended for teachers and students, also contains an overview of environmental problems, the addresses of environmental in-

[8] Anne Royaux-Defeyt and Daniel Rousselet: "Ecologie et éthique au quotidien", in *Actes des XIIIèmes journées internationales sur la communication, l'éducation et la culture scientifiques et industrielles* (Chamonix, 1991), pp. 229-234.

[9] Monique Fitzback and Claude Duchesnau: "Une opération d'éducation relative à l'environnement pour jeunes et adultes au Quebec: Ensemble, récupérons notre planète", ibid., pp. 412-418.

stitutions and resource people, and a description of existing educational materials that can be used in the projects. An informative schedule of forthcoming events helps participants to plan and co-ordinate their educational activities, both locally and nationally. The response of participants to the "Together, let's salvage the planet" programme has been enthusiastic.

France: "At the forest school"

In 1991 France's Ministry of Agriculture and Forestry launched a national programme to raise awareness among primary school students about forest protection and management issues. The programme includes teacher training, the preparation of locally adapted educational materials, and the organization of concrete educational projects in forest areas.[10]

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b. Environmental education in the community

A community approach to environmental literacy and education has often proved extremely effective in triggering individual and community action to introduce sustainable production activities in local communities, as illustrated by the following examples.

Burkina Faso: The introduction of solar cookers

It is widely acknowledged that the huge debts accumulated in many poor countries are the result of ill-conceived policies of development and technology transfer during the past 30 years. The servicing of this debt has contributed to accelerated, unsustainable exploitation of these countries' natural resources. Ecological imbalances in tropical rain and dry forest regions have resulted in rapid desertification. It is a vicious circle: poverty breeds environmental destruction which in turn breeds poverty.

In an effort to eliminate the root causes of environmental destruction, the Centre Ecologique Albert Schweitzer has been using environmental education as a tool to change household practices and habits in Burkina Faso, in Africa's Sahel region. In collaboration with local organizations, Centre staff have been

[10] Henri Daburon: "Une action de formation à long terme dans les classes primaires: Le projet "A l'école de la forêt", ibid., pp. 401-405.

encouraging women to use solar cookers and change their cooking habits in order to reduce the use of wood for cooking, a major cause of deforestation in the country. Persuading women to change their cooking habits is the hardest task, but the women are also sceptical about the simple but energy saving "new" cooking technology. In the words of one of the Centre's collaborators in Burkina Faso:

"The women approach the solar oven and put their hands into it. Some go on their knees and look for the fire under the [solar oven] box. After some explaining, they acquiesce, taste the food, admit that it is good, but you can feel them saying that you cannot make food without fire. Most women cook once a day, at noon, for two meals in order to save on wood. The women prepare the meal between 10 and 10.30 a.m., after having been to the market for two hours to buy food and socialise with other women. The meal has to be ready by 12.30-1.00 p.m., when the husband and the children come home. Using the solar cooker, women need to return from the market by 8.30, in order to put the food into the cooker sufficiently early. This means an important change in their social life". [11]

The Amazon Basin: The Health and Happiness Project

The Amazon Basin is an invaluable part of mankind's heritage. However, uncontrolled colonization and exploitation are jeopardizing the ecological balance of the region and the livelihood of many people, particularly indigenous populations. Many programmes and projects have been introduced to address the deteriorating environmental situation.

One of these is the Health and Happiness Project in the Santarem region of Pará State in the central Amazon.[12] The project is financed jointly by national development banks and universities, national and international environmental oganizations, and UNICEF. It is an experimental and multidisciplinary community development programme combining health and environmental education, art, communications and rural production. The objective is to promote a sustainable pattern of development. It operates in 16 rural communities and 94 river-bank settlements and covers 25,000 people.

[11] Frédéric Marthaler: "Le four solaire, c'est pour aujourd'hui", ibid., pp. 352-357.

[12] Ricardo Braun: *Environmental education and training in Brazil*, Training Discussion Paper No. 84, (Geneva, ILO, 1992), pp. 83-86.

The project's aim is to trigger a process of comprehensive human, economic and environmental improvement by mobilizing locally available human, cultural and natural resources. The project involves community training, appropriate technology development, and provision of technical support. The objective is to encourage people to take an active role in their own development.

A multidisciplinary team consisting of doctors, nurses, agronomists, veterinarians, teachers, artists and others provides training and technical advice and acts as a catalyst for activities that promote health, education, art, communication and rural development. One of the team's major achievements has been to set up the Mocorongo Health and Happiness Circus – "Mocorongo" meaning native of Santarém. Performances take place in the evening in community centres, and attract crowds eager to participate. Everyday activities are reflected through education, dancing, music, folklore and the discussion of community problems. Everyone – children, parents, farmers and others – becomes an artist. The circus and other artistic activities have been the main tools for communicating with people and mobilizing their energy for development activities. During the team's visits to an area, educational activities are used to involve as many people as possible from all age groups. The days are very busy and a large proportion of the population is mobilized.

Environmental education permeates the entire programme. It seeks to increase people's self-awareness and environmental consciousness, and to provide them with the tools to interact with the environment in a sustainable manner and to revitalize their local culture and identity. The project is also providing teaching support to schools, making them centres for generating knowledge, participatory research and cultural revival.

The project's *child health and happiness work* is carried out by students and teachers, who discuss health, hygiene, ecology, farming, art and theatre with young people aged 7-14, encouraging them to work with their families and take care of their younger siblings.

A formal education programme encourages the formation of study groups which can act as "education and culture agents", explaining the project to the community as a whole and helping people find solutions to environmental and community sanitation problems. This methodology is used in the first to the fifth grade of primary school.

Under the *environmental health programme* health monitors learn the practical and theoretical skills to provide first aid and diagnose and cure common illnesses. The programme puts a strong emphasis on personal and

family hygiene, in particular the chlorination of water and improvement of toilet facilities. The environmental health situation in the area has been improved through a number of mutually supportive activities. These include health education, the training of health workers, improvements in hygiene, sanitation, and nutrition, an integrated approach to women and children's health, measures to control disease, dental hygiene, use of simple methods to cure illnesses and health monitoring through the use of indicators (participatory diagnosis).

Finally, the project organizes seminars on the topics of environmental science, culture and art in the Amazon.

c. *Environmental learning strategies*

Despite the different contexts and approaches, these examples do pinpoint some common difficulties in implementing environmental literacy programmes. These fairly successful programmes should not hide the fact that most environmental education has been ineffective in delivering the environmental message and changing attitudes and behaviour. The poor outcome of many programmes can be attributed to various factors, including the difficulty of defining programme objectives and identifying areas for study. It is often hard to decide which environmental systems should be studied and how their links with human activities should be explained. Most programmes are not tailored to the needs and educational and cultural background of their participants. They often fail to combine scientific information with ethical appeals in a language that people understand.

Generally, environmental education programmes have been unable to correct a number of misconceptions about the environment, for example the belief that renewable resources such as fish and wood are infinite and that science and technology can solve all environmental problems, for example by installing pollution-abating filters in factories. Programmes often fail to convey the understanding that changes in lifestyles are a prerequisite for sustainable development policies. What follows is an analysis of some of these difficulties and the means to overcome them.

The learning difficulties

There are two main obstacles to the success of environmental education. One is the fact that the environmental message is related to changes in behaviour that are difficult to achieve. The second is related to the difficulty of under-

standing the relationships between human activities and the environment. Targeting the message is also essential, as explained in Box 1.

Box 1

Targeting the environmental message

Environmental education can be developed as a series of messages addressed to the public. However, a "general message"can be weak, because it is not addressed to a specific target group. It is therefore necessary to define the target group and analyse its characteristics before formulating the message.

The meaning of a message depends not only on the message itself (content and context) but also on the target or receptor. Each receptor gives specific meaning to a message, using his or her capacities for understanding. These capacities are built up using both the individual's experiences and the language and social norms of the community. If the target lacks the capacity to understand the message, it is useless to send it. Frequently the target gives the message a different meaning from that intended, often with negative effects. For example, an analysis of adults' understanding of scientific programmes on television suggests that viewers often misinterpret or fail to understand the intended message. The same sort of thing seems to occur with other mediums, such as posters. For these reasons it is vital to identify the target clearly and to take account of other factors such as the context in which the message is given, how it will combine with other messages, and what changes in behaviour are looked for.

The first obstacle explains why just talking about environmental degradation is not sufficient to obtain changes in behaviour. People may agree that it is important to reduce the use of cars, to cut down waste production or to consume less energy, but few individuals are really disposed to make the effort to change their own behaviour. For this reason environmental education may be more effective if it is organized around positive messages, focused on how environmental protection can improve the quality of life. The negative messages can provoke a negative reaction because people do not like to feel guilty.

The second obstacle basically relates to the difficulties of understanding the environmental processes themselves: the difficulty of understanding complex systems and the simultaneity of environmental processes, the lack of basic scientific knowledge, and the difficulty of understanding processes that involve either small dimensions (such as molecular processes) or large dimensions (such as meteorological processes).

The simultaneity of environmental processes

Our language can only enunciate facts in a linear way, one after the other. However, environmental systems involve a great many simultaneous processes. Different environmental systems are linked to each other, and do not have precise boundaries between them. The same element can be part of different systems at the same time; for example, photosynthesis is a process that occurs in plants, but it also changes the concentration of carbon dioxide and oxygen in the air and changes the quantity of water in soils. All human activities are intertwined with environmental processes.

The need for basic scientific knowledge

Basic scientific knowledge is a necessary condition for understanding environmental systems. Environmental work demands an understanding of the way matter is organized at different levels, each level having specific characteristics, for example, atoms, molecules, cells, living organisms, populations and ecosystems. This basic scientific knowledge also includes concepts such as transfer of matter and energy, chemical reactions and the trophic network (which explains which species consume other species).

The dimension problem

We tend to see objects and phenomena in a "macroscopic dimension" as measured by millimetres, metres, minutes, kilograms, etc. However, environmental processes occur either in very small dimensions (atoms or molecules, milliseconds) or large dimensions (hundreds of kilometres, thousands of years). Experience shows that it is very difficult to understand these dimensions, and the processes associated with them.

Towards effective environmental education

Environmental education research indicates that most of these obstacles can be surmounted if the environmental educational programme is organized around three elements: an analysis of students' beliefs, identification of the learning obstacles, and the use of particular concepts that help surmount the obstacles (structurant concepts). This methodology is used in many schools in different countries (Italy, France, Spain, Switzerland, etc.). We will discuss this strategy further in Part IV.

2. Job related environmental literacy training

"Countries and educational institutions should integrate environmental and developmental issues into existing training curricula ..." (*Agenda 21*, Chapter 36.16).

All economic activities have an impact on the environment, some more, others less. Environmental literacy training can contribute significantly to making economic activities environmentally sustainable. The impact of various jobs on the environment, and therefore the potential positive impact of such training, will vary depending on the nature of the activity. Training given to a secretary may have less potential impact than occupation-specific environmental training given to an engineer who designs chemical processing machinery. However, there is scope for integrating environmental literacy training into all occupational training programmes. Such training is also essential for trade unions, environmental organizations and other groups that need to be able to defend their interests in negotiations and decisions that have a bearing on the environment.

Although the ultimate objective of environmental literacy training remains the same – to contribute to a safe, healthy and sustainable environment – its scope, depth and content will vary considerably between occupations and between professional and economic activities concerned.

Today, as the emphasis in training is shifting away from pollution control training for **specialists** towards *environmental literacy training* **for all**, such training is increasingly becoming an integral part of vocationally oriented training programmes at all levels. Examples of some pioneering efforts in job-related environmental literacy training are given below. They cover experiences in both university and non-university settings.

UCLA, California, USA: Integrating environmental literacy training into chemical engineering courses

At the University of California at Los Angeles (UCLA), the chemical engineering courses were considered a good starting point for developing environmental literacy training. In a first phase of programme reform, the approach was to identify the sources of chemical pollution, for example by carrying out life cycle analysis, keeping track of all the energy that goes into a production process, and identifying means of preventing pollution at the source. A case-study book was prepared to help students identify pollution problems and find solutions to them. The next step was to integrate environmental issues and literacy into the chemical engineering *design* course programme. The objective was to develop skills for designing clean chemical processing technology by making all engineering students environmentally literate.[13]

Tuft's Environmental Literacy Institute, Boston, USA: introducing environmental literacy training into mainstream university programmes

The Environmental Literacy Institute at Tuft's University' in Boston has pioneered the integration of environmental literacy into the university's mainstream programmes and is considered a benchmark model in this area. Departments of all faculties (civil engineering, architecture, law, medicine, humanities, etc.) were invited for a two-week workshop to redesign their course programmes, impregnating them with environmental content. Professors were given a US$2000 stipend on condition that they actually implemented the reformed programme. For example, the Spanish language professor incorporated environmental studies in the course by including in the reader (course literature) environmentally oriented case-studies and role-playing exercises with a Spanish flavour. The objective was to embed environmental issues deeply into the course. The approach is now being disseminated in other universities in the United States and elsewhere.[14]

[13] One of the authors collected this information during an interview with Prof. George Allen, Department of Chemical Engineering, UCLA, Los Angeles, Mar. 1992.

[14] idem.

United States: Environmental literacy training in business schools

Independent bodies and associations are promoting environmental literacy training for the *business world*. One such body is the Environmental Management Institute in Washington, DC, a non-profit organization, the brief of which is to promote the integration of environmental issues into business school and university curricula and programmes. The Institute's work has two prongs: one directed at the future managerial workforce, the other at the training of trainers.[15]

As far as the *future managers* are concerned, the aim is to endow them with a basic awareness about environmental issues, to familiarize them with environmental laws and regulations, and to equip them with the requisite values and conceptual and analytical tools to integrate environmental concerns into day-to-day decision-making in business. Environmental issues are integrated into each course. For example, environmental cost accounting is integrated into corporate economic analysis, and the marketing course helps students analyse the environmental implications for a company and its stakeholders of its marketing strategies. The programme aims to convey, through case-studies and simulation exercises in an interactive educational process, the often conflicting situations that a company faces when attempting to implement its environmental policies.

For its training of trainers programme, the Institute organizes workshops involving faculty members and representatives from industry. The Institute is at present implementing a pilot programme in four business schools in the United States. For this purpose it is preparing guidelines for curriculum development, while investigating how students can be encouraged to work in the environmental management area. *The Advisory Boards of schools and universities* are important bodies as regards promoting the programme. Composed of faculty and industry representatives, they advise on course programmes in order to help them meet identified industry needs. For example, the Advisory Board to the Business School at the University of Texas, Austin, has been instrumental in developing an environmental management training programme that fits the needs of the oil and gas industry. Several members of the Board are oil and gas executives.

[15] This text is based on an interview with the Institute's Director, Mr Derek Long, Mar. 1992, Washington, D.C.

Hungary: Environmental literacy training in secondary vocational schools[16]

In the recent past, vocational secondary schools in Hungary have lacked a coherent environmental education programme. The same can be said about technology education. This is all the more noteworthy since the majority of 14-year-olds continue their studies in secondary vocational schools once they have completed compulsory general education. Increasing social demand for environmental education was the springboard for the Development Project for Environmental Education in Vocational Training (1987-90). The National Institute of Education (NIE) and the Ministry of Environmental Protection and Nature Conservation designed the project and the Ministry of Trade and Commerce provided financial and technical support.

The initial general and specific ecological and environmental protection curriculum was worked out by a research team. The object was to help students develop an up-to-date and enlightened view of the environment. In pursuing its task, the team had some major problems to confront. One of these was the complicated structure of the vocational education system, with its proliferation of general, vocational and theoretical subjects, the large number of lessons per week, and subjects crammed with excess material. Another problem was that vocational education is supervised by several ministries that do not necessarily have the same objectives. Finally, in many schools the curriculum lacked certain science subjects, such as biology and/or geography, that would have provided a means of linking the various elements of ecology and environmental education. Basic general and specialized subjects lacked any environmental content, and teachers failed to seize opportunities to link environmental issues to other subjects.

The environmental curriculum has two major parts. The first comprises general information on environmental protection that is common to all types of secondary vocational school. This part builds on environmental education programmes in elementary schools that aim to develop correct attitudes towards the environment. The second part, which varies according to occupation, consists of specific, occupationally related information on environmental protection, including information on environmental protection technologies and

[16] András Benedek and Agnes Kohl: *Environmental education and training in Hungary*, Training Discussion Paper No. 83 (Geneva, ILO, 1992).

methods of recycling waste. This information is used in specialized areas such as knowledge of materials and technology training.

The general principles that guide environmental education are that the living creature, primarily the human being, has a central role; that biological, social and economic life should be seen as interlinked systems, and that environmental education is essentially multidisciplinary.

This curriculum was taught in a pilot programme called "Man and the Environment" in six schools over a period of two years. In addition to the textbook and the programme curriculum, teaching materials included practical exercises, slides and a teacher's manual.

The environmental education programme also developed teacher's manuals to help teachers integrate environmental education into the curriculum of history and certain science subjects.

Hungary: Environmental literacy training for nuclear power plant employees[17]

Another interesting example of an environmental education initiative in Hungary, albeit of an ad-hoc nature, is the environmental education programme at the Vocational School of Energy, which was founded by the Paks Nuclear Power Plant in 1986. The school's training programmes centre around the use and production of nuclear energy, the mainstay of the plant's activities.

As part of their formal education in power plant engineering, students study both radiation protection and environmental pollution by non-nuclear power plants. For their fieldwork in the control zone of the nuclear plant, they must pass an exam covering the companys rules and regulations on radiation protection. In the course of this fieldwork – carried out under the supervision of regular employees – the students are given an opportunity to familiarize themselves with the plants dosimetric laboratory. They learn to measure natural radiation and to read the thermoluminescence counter of personal dosimeters used for determining the quantity of ionizing radiation absorbed by living organisms. They are introduced to the control systems that measure the amount of radioactive material released from the plant.

[17] Ibid.

In their training on power plant engineering and nuclear plant technologies, the students learn about the normal running of an RBMK-1000 reactor of the Chernobyl type and analyse the Chernobyl breakdown and nuclear plant accident. They are introduced to the technical, organizational and operational measures contained in the companys contingency plan in case of a Chernobyl-type emergency.

As members of the Scientific Society for Energy, some of the students and instructors attend scientific lectures on energy production. In the autumn of 1990, they attended a symposium on environmental protection, learning about the biological and genetic effects of radiation. Several students have entered a recent essay competition on environmental protection.

The school has joined the national acid rain measurement network, organized by Lorand Eötvös University. The students collect samples of rainwater, measure their Ph values (a measure of acidity) and submit their results to the national network. Some of the training is given by plant employees who are qualified technical teachers.

The general publics knowledge of the nature and operation of nuclear power plants is sketchy. The Information Bureau at the nuclear plant has therefore arranged a forum for discussing questions of public interest. It has published books and journals in order to promote a general understanding of matters related to the controversial issues of nuclear energy. A special course on nuclear technology has also been arranged for humanities teachers.

Milan, Italy: Learning the techniques of environmental impact assessment (EIA)

Ideally all investment decisions should be preceded by an assessment of the environmental impact (EIA) of the investment. More and more EIAs are now being made in order to comply with national and regional (for example EU) legislation and directives. EIAs are generally carried out by specialists, who require advanced multidisciplinary skills and training. However, professionals who, for example, plan infrastructural, industrial, agricultural and tourism developments also need some basic understanding of the impacts these developments are likely to have on the environment. The two illustrations that follow are representative of efforts to instill this understanding.

The use of computerized information processing can greatly facilitate EIA, as it permits long and complex calculations and iterations to be made easily and encourages the user to express technical jargon clearly. The Milan Poly-

technic has developed a training project called SILVA (Software Interattivo per la Valutazione di Impatto Ambientale – Interactive Software for the Evaluation of Environmental Impact) that looks at the methods and tools used in managing EIA activities.[18] A basic course introduces trainees to the use of software for organizing EIA activities, analysing territorial characteristics, evaluating impacts and choosing between alternative territorial development patterns. There is also a theoretical course on EIA methodology and a course explaining the use of software for EIA. The basic course is intended for professionals who need to undertake EIA. The further training courses require a good knowledge of the subjects covered in the basic course.

The National Association of Sanitary Engineering and the Institute of Sanitary Engineering at Milan Polytechnic have developed a training course for sanitary technicians and professionals working in sewage plants by the Po and Lambro rivers and the Adriatic Sea.[19] These people need skills in evaluating the environmental impact of sewage. The course addresses the technical and scientific aspects of air, water and soil pollution and the criteria for environmental protection. The course covers general environmental themes; measurement and monitoring techniques; specific problems relating to measuring air, soil and surface and subterranean water pollution; the eco-toxicological elements of environmental impact and the normative and technical aspects of environmental impact evaluation.

3. Environmental training for people engaged in environmental protection jobs

The scope, content, depth and intensity of environmental protection training varies, ranging from short-term (a few days) upgrading seminars for established environmental professionals to longer-term (several years) intensive training in higher education and training institutions. Here we will give examples of training for different environmental protection activities.

[18] Raul Gaghardi: *Training for environmental protection in the Lombardy and Umbria regions*, Training Discussion Paper No. 74, (Geneva, ILO, 1991), p. 23.

[19] Ibid.

Mario Negri Institute: Milan, Italy: Training for environmental research

Research in environmental protection requires the building of knowledge and the development of multidisciplinary skills. Graduates in fields such as chemistry, biology, ecology, physics, pathology or molecular biology must receive complementary training if they want to work as researchers in environmental protection. Accordingly, researchers in this area take postgraduate courses that complement their original background. Such training should develop the capacity to deal with complex systems and at the same time develop highly specialized laboratory skills.

At the Mario Negri Institute for Pharmacological Research in Milan, university graduates in biology and pharmacology can follow an intensive training programme, working in the Institute's laboratories for three years under the direction of the Institute's senior researchers. The goal of the training is to develop students' capacity to work autonomously in the laboratories of industries and public enterprises undertaking such activities as measuring chemical pollutants and analysing their carcinogenic and genetic effects. The Institute also organizes the training of laboratory assistants.

The objective of these training activities is to stimulate the development of specific research skills. The strategy is to give the students a research subject and incorporate them into one of the Institute's laboratories. The students are thus "immersed" in the laboratory's activities and can help to solve the laboratory's current problems. At the same time, they learn how to organize their research, analyse a bibliography, and develop other skills invaluble for future employment. The training lasts three years and is funded by a small grant from the Institute and the European Community.

One course run by the Institute is organized by the Ecotoxicology Laboratory. It studies the toxic effects of chemical pollutants and is divided into two main parts:

(i) measurement of the concentration of pollutants in air, water or soil, using techniques such as mass spectro-photometry (measuring light absorption);

(ii) measurement of the effects of the pollutants on animals: for example, their mutagenic effects, their linkage with proteins and DNA, their cancerous effects, their removal by the kidneys, etc., using techniques of physiology and molecular biology.

These activities require the use of theories and instruments from different disciplines (molecular biology, biochemistry, analytical chemistry, etc.). The researchers and technicians who work in environmental toxicology must therefore undergo long and intensive training in order to acquire this complex scientific knowledge and to develop the skills needed to complement their own basic training.

Partnership for Environmental Technology Education, United States: Harnessing community colleges for environmental training

The need for a broad co-operative effort directed towards the enhancement of science and mathematics education, including environmental science and technology, has been recognised as a national priority in the United States by the government, industry, and the academic community alike. In an effort to address this need, the Partnership for Environmental Technology Education (PETE) has been established in the five western states of Arizona, California, Hawaii, Nevada and Utah.[20] PETE's overall objectives are to link the technical resources of the Department of Energy (DOE), the Environmental Protection Agency (EPA), the Department of Defense (DoD), NASA laboratories and facilities, and private industry with participating community colleges, to help the colleges develop curricula for training "environmental-hazardous materials technicians", and to encourage more transfer students to pursue four-year courses in environmental science and engineering. Generally speaking, PETE will support the development of training materials and programmes relating to critical environmental technology.

Among PETE's activities so far, the convening of twice-yearly Resource Instructor Conferences can be mentioned. These provide a forum for information exchange and mutual support among participating community colleges and the other regional partners. At the second conference the focus was on the issue of private sector demand for environmental-hazardous materials technicians and the pros and cons of developing national certification standards. During the summer of 1991, PETE assisted in the initiation of environmental-hazardous materials training programmes at two community colleges in the State of Nevada. PETE sponsored the training of the two selected instructors at the UC Davis-Extension six-week intensive programme. Eight new programme start-

[20] Paul Dickinson: *Partnership for environmental technology education*, Training Discussion Paper No. 106 (Geneva, ILO, 1992).

grants were made to community colleges by PETE for the summer of 1992. A national study of demand and skills requirements for environmental-hazardous materials technicians was initiated by the National Center for Research in Vocational Education. In May 1992 PETE initiated the Summer Internship Program, whereby eight community college instructors spent six to eight weeks at the laboratories of the Nevada Test Site working in waste operations, environmental restoration and research and development projects.

At the time this book went to print, PETE had become a national programme. Today it covers 6 regions in the entire country and a large number of the 1222 community, technical and junior colleges belonging to the American Association of Community and Junior colleges. PETE constitutes one of the pillars in the strategy of the American Alliance for Environment and Trade whose brief it is to create an effective environmental technology service network with industry, the national laboratories, state and local governments, universities and environmental organisations.

Italy: Training for environmentally sound sewage management

In Italy, thousands of sewage disposal installations do not work satisfactorily. While the managers are accused of being incapable of managing, the managers themselves blame the poor installations.[21] In response to this problem, FAST (Federazione di Associazione Scientifice e Tecnice – Federation of Scientific and Technical Associations) has organized two courses, one basic and one advanced, specifically directed towards the managers of sewage disposal installations.

The basic course aims to provide a fundamental understanding of the phenomena linked with the sewage disposal process. Computer simulations permit an analysis of the effects of various modifications of the process variables. This understanding should facilitate the management of both standard and emergency situations.

The advanced course was created in response to new standards for preventing the eutrophication of lakes and of the Adriatic Sea. These standards require installations to remove nitrogen and phosphorus from treated sewage. Although the adapted biotechnologies are new to the Italian market, more than a hundred of these installations will be built in the next three years.

[21] Gagliardi, op.cit., p. 24.

The advanced course will train qualified technicians to manage these complex installations. The course is addressed to managers of sewage disposal installations with more than one year of experience, and to tehnicians and professionals who work in related activities.

Training for agrotourism management

The ACLI (Associazione Cristiana di Lavoratori Italiani) is one of the biggest Italian workers' organizations. The EnAIP (ACLI Institution for Professional Training), one of its subsidiary institutions, is one of the largest training facilities for professional activities in Italy. Twenty-five percent of professional training in the Lombardy region is organized by the EnAIP in conjunction with public institutions.

One of the training activities related to environmental protection organized by EnAIP Lombardia is linked to the development of "agrotourism", which is a method of developing tourism without a negative impact on the environment. In addition, the project is oriented towards providing employment opportunities for young people. One of EnAIP's general goals is to promote vocational training for unemployed youth.

The programme trains "environmental tourist agents" (operatori turistico ambientale) who organize tourist activities compatible with environmental protection. At the end of the course, the students should be able to:

- promote and organize tourist activities;
- co-ordinate physical, economical and human resources;
- know the region in detail.

The course is intended for young people (18-25 years old) who have completed their senior secondary schooling. It lasts 460 hours: 270 in the classroom, 40 for visits, and 150 for practical experience.

University of Brazilia, Brazil: Masters course in ecology[22]

Since 1976 the University of Brasilia has offered a masters degree in ecology. It is currently co-ordinated by the department of ecology of the Institute of Biological Science.

[22] Braun, op.cit., p. 37.

The course focuses mainly on the cerrado (savanna) ecosystem, which is predominant in the central-eastern part of Brazil, and aims to develop evaluations of the environmental impact of natural resources exploitation. Areas of study include:

- population ecology (insects) and management and planning of protected areas;
- bio-climatology, energy balance and hydrological balance;
- insect ecology and the impact of fires in the savanna;
- vertebrates: ecology and behaviour, animal population, fauna conservation and management;
- natural resources planning and management;
- environmental evaluation-biological monitoring of humans and mammals in general.

University of São Paolo, Brazil: Post graduate environmental science programme[23]

Created in 1989, this programme is co-ordinated by an Integrated Inter-Disciplinary Centre, which is part of a network involving all institutions and faculties in the University of São Paolo.

The main purpose of the programme is to develop integrated studies of earth dynamics, with an emphasis on Brazil's major environmental problems. The programme also focuses on environmental impact assessment (EIA) of natural resources and energy resources utilization. The basic objective of the course is to give a holistic view, beyond economic evaluation, of human and natural resources utilization.

In addition, it is expected that the programme will lead to the creation of a documentation centre on environmental topics, and the creation of a national and international institutional network to look at environmental problems.

[23] Ibid, p. 36.

The lessons

To sum up, people who undertake environmental protection work need specific training. It is difficult to analyze what this training should consist of because many different environmental activities are undertaken by different professionals and technicians. Some of these activities are not new, for example many jobs in existing utilities such as water treatment and waste disposal. Other activities are new. For these, occupational and skill profiles have to be defined and training programmes organized. For example, scientists and researchers need to be trained to study the environment and forecast the possible impact of human activities such as the impact of pollution on human, vegetal and plant health and to develop new systems to reduce pollution and waste. This training may also be relevant to enterprise staff who are responsible for ensuring that the company meets emission standards and environmental regulations, the staff or outside experts who prepare the company's environmental audits, and the professionals working in national, regional and municipal environmental agencies or administrations who formulate environmental policies and undertake environmental supervision, monitoring and advisory activities.

Environmental activities for which specific training is needed include:

- organizing environmentally sound tourism;
- protecting the sea environment;
- hazardous materials treatment and disposal;
- waste disposal.

B

The environmental labour market

People in many different jobs – and potentially all the employed workforce – need some form of environmental literacy training in order to make their jobs compatible with a sustainable environment. To that extent the "environmental labour market" is very large. Although environmental training can be

seen as a need, this need is not necessarily translated into effective demand on the part of organizations and individuals. The demand for environmental literacy training is determined by many factors:

- public environmental policies;
- pressure by stakeholders on enterprises to maintain an environmentally sound image;
- management's commitment to environmentally sustainable practices;
- management's ability to motivate staff to improve their environmental job performance.

The situation is somewhat different with the market for environmental protection jobs, which we may define as the *environmental labour market proper*. Public environmental policies largely determine the demand for environmental professionals in the public sector, and also indirectly in the private sector. In the recent past the environmental labour market has been fairly stable. Employment in environmental protection jobs has for some time comprised 1-2 per cent of total employment in, for example, France and Germany, less in some other countries. As long as environmental policies continue to put the emphasis on corrective measures, the effective demand for environmental skill and literacy training is not expected to increase significantly.

Training for environmental protection must respond to an employment market which is fragmented and in rapid transformation, in which the traditional professions evolve quickly and new professions continue to develop. To cope with constantly emerging environmental problems, a flexible in-service (on- or off-the-job) training system is essential.

The diversity of environmental protection jobs and the mixture of traditional and new activities is well illustrated in the French environmental labour market, described below.

1. The environmental labour market in France

In 1987, the environmental sector comprised some 350,000 jobs in France (1.6 per cent of the economically active population), distributed as follows:

Production jobs in "eco-industries"	90,100
Production jobs in "other industries"	3,500
Non-production jobs	79,400
Administrative jobs	123,400
Self-employment	53,000
TOTAL	349,400

Almost half of all environmental jobs (160,000) were in water treatment; waste disposal is the other major area:

Water treatment	160,000
Waste disposal and recycling	99,330
Landscape management (**cadre de vie**)	27,500
Noise abatement	25,000
Air pollution control	15,000
Ecological patrimony	19,700
Administration	3,000
TOTAL	349,530

Growth in environmental employment has been slow: 343,000 jobs in 1985, 349,200 in 1986, 349,400 in 1987 and 353,000 in 1988. Environmental protection is therefore not an important source of new jobs. In future, most new jobs will be in the environmental services of enterprises and local authorities. In industry, the focus will be on pollution and noise control, the evaluation of industrial risks, and improving enterprises' environmental information and communication services. Industrial environmental management is a source of new jobs in large companies and consulting firms.

There are also environmental jobs in research and development activities, such as solving noise problems, measuring the toxicity of products, treating waste, and reducing smells. Local authorities and associations are another important source of environmental jobs. They offer, for example, jobs in landscape management, waste collection and management, and environmental tourist development.

a. Categories of environmental jobs

The French Ministry of Environment has divided environmental jobs into four major categories:

Pollution, "environmental noise" and risk prevention and reduction

This category covers areas such as air, water, noise, waste, risks, energy and soil. Under this category come occupations such as water quality maintenance technician (**agent d'entretien de la qualité de l'eau**), wardens responsible for waste disposal (**déchetterie**), sewage station technicians, hydraulic engineers and inspectors of classified dangerous sites (**inspecteur d'installations classés**).

This category comprises the largest number of environmental jobs and is expected to grow in the future through the development of new technologies and eco-products. These jobs require professionals with scientific training.

Protection of nature and management of natural resources

This covers areas such as flora and fauna, land and aquatic eco-systems. Some jobs are of the traditional type, such as forestry technicians, fish wardens, game wardens, horticulturists and researchers. More recent jobs are biological farmers, river and park technicians, and managers of nature parks. Some jobs are very new, combining, for example, gardening and educational activities.

The number of environmental jobs in this category is limited. Professionals who work in this area need a natural science background.

Landscape management (cadre de vie)

This category covers activities related to landscape management, town and rural planning, and park management. It covers traditional jobs such as gardeners, public works engineers and foresters, and more recent jobs such as urban and rural planners.

This category is growing, particularly at the regional, departmental and city levels. Training is provided in agricultural schools (**lycées agricoles**) for

landscape management jobs and in universities and the "grandes écoles" for engineers.

Environmental consulting

This category comprises professionals undertaking impact studies and environmental audits and providing consulting services. Jobs include environmental advisers, specialists in particular environmental disciplines, and environmental educators.

The educational requirements are similar to those for the other categories, although some professionals may have a social science background, for example in economics and sociology. It is generally necessary to have specialized in environmental studies. Environmental consulting jobs can be found in local environmental administrations, enterprises and environmental consulting firms. Environmental educators trained in programmes run by the Ministry of Youth and Sports may find jobs in environmental organizations. Environmental advisers are generally trained in universities and engineering schools.

b. Some typical environmental jobs

Environmental advisers

Also called eco-advisers, these are general practitioners in environmental matters and give advice to local authorities, small and medium-sized enterprises, farmers, etc., covering activities as diverse as urban planning, the management of new industrial sites, and cleaning up rivers. Training for this type of activity has grown steadily in both Europe and the United States. In Austria, for example, there are now some 800 eco-advisers. They act as links between the authorities and the public, suggest environmental protection priorities, undertake environmental studies, and stimulate debate on environmental issues.

Eco-advisers may work in town and environmental planning bureaux, in consumer associations, in regional councils and in municipalities. In France they are trained at the Institut Eco-conseil in Strasbourg, from which some 100 eco-advisers have graduated since it was founded. Students have different backgrounds, for example in ecology, chemistry, agronomy and medicine. The institute provides theoretical and practical training on various environmental

issues such as waste management and improving the quality of the natural environment.

Ecological engineers (ingénieurs écologues)

This is a new occupation. Ecological engineers are general practitioners providing environmental advice, but they are particularly oriented to the study of living organisms and eco-systems. Numbering 250 at present, they work in activities such as territorial management, natural park management, environmental impact assessment, and pollution control and reduction. They also analyze the environmental impact of large construction projects.

Ecological engineers need a baccalaureate plus five years of study in agronomy, biology or the natural sciences and one year of ecology studies. Most have a masters degree in biology, with an environmental specialization. Many ecological engineers work in the public sector, for example in government ministries, the Conseil Supérieur de la Péche, national parks and local communities. Private sector jobs include those in research offices (**bureaux d'études**) and eco-industries.

The work of ecological engineers and other professionals, for example engineers with supplementary environmental training, often overlaps. Frequently enterprises prefer the latter.

Environmental inspectors

Environmental inspectors supervise and control public or private equipment which can damage the environment through water, air or soil pollution. Many work in chemical enterprises, while others inspect subterranean parking facilities, laundries, animal-breeding facilities and other establishments, ensuring that they meet security and environmental norms and imposing fines and administrative sanctions when justified. In France there are some 600 inspectors covering some 500,000 establishments.

Environmental firemen

Their role is to provide assistance in the case of environmental disasters and pollution incidents. They receive a broadly based training with a special focus on pollution control.

Eco-toxicologists

Eco-toxicologists evaluate the adverse environmental impact of different products. They tend to work as teachers or researchers in eco-toxicology, or in chemical industries. They should have a background in pharmacy, chemical engineering or medicine, plus training in ecology and toxicology. Eco-toxicology can be studied at the Universities of Metz and Rouen.

Environmental lawyers

Today there are 600 candidates for 50 places to pursue environmental law studies at the University of Paris. Environmental law is a specific subject, which overlaps with criminal law, civil law and public law. Environmental lawyers need a broadly based training, including training in French and European Community legislation. They write environmental texts and regulations and help solve environmental conflicts. They advise enterprises on their environmental policies and on environmental legislation. They also work for local government and research institutions.

Ecological wardens (Gardes nature)

Their job is to protect natural habitats. They generally need a background in forestry or environmental protection at higher technician level (Baccalaureate Technician Supérieur).

c. The cultural context of environmental training

In order to be effective, environmental training must be sensitive to the culture and customs of the particular community in which the training takes place.

Any human activity implies changes in the environment. An activity is sustainable – that is, it can be maintained over long periods without adverse environmental transformation – when the changes are compensated for by the environment. Environmental degradation begins when the changes are not compensated for.

The sustainability of an activity depends partly on its dimensions. Burning small forest areas for agriculture in the Amazon forest is a sustainable activity. On the other hand, burning hundreds of square kilometres of forest for animal husbandry has an adverse environmental impact on the entire planet. Economic growth, population growth and technology often have an adverse impact on the environment. The introduction of motorized fishing boats, for example, increases the fish harvest, but may also result in excessive fishing and the disappearance of fish species. The growth of fishing communities may also cause pressure on fish stocks and lead to overfishing.

Another important element for the sustainability of an activity is its synergy with other activities. For example, modest use of fertilizers in agriculture does not cause significant environmental change. However, excessive use of fertilizers causes severe environmental damage, such as water eutrophication. This phenomenon is even more severe when the water is also polluted by phosphates from domestic activities.

Many traditional century-old activities are no longer sustainable and should be reduced or abandoned. Unfortunately, members of a community often do not want to change their way of life. They will need to be convinced of the necessity for change and persuaded to transform some economic activities, and to engage in new activities that are sustainable and can contribute to higher incomes and a better quality of life. However, environmental protection is a relatively new concept and in many communities environmental degradation does not become an issue until it is irreversible. That is why it is necessary to organize environmental education and training campaigns addressed to the community.

The probability of success is greater if the education programme takes into account the culture of the community. Each society tends to develop the environmental knowledge, skills and practices needed to ensure its livelihood and survival. However, society also develops beliefs that justify activities that are environmentally unsustainable. For example, communities develop the skills to use renewable resources such as wood, fish etc., while often believing that these are infinite and can be exploited without limit. Such beliefs have led to excessive exploitation and the disappearance of these resources.

Environmental knowledge and beliefs are transmitted from generation to generation. They strongly influence the activities of the community. The community's culture can be both a positive and a negative element in environmental education and training. It provides a basis upon which to build new knowledge. At the same time it can hinder new learning and the undertaking of new activities. Environmental education and training programmes should there-

fore endeavour to reinforce empirically correct knowledge and skills while helping people to abandon unscientific beliefs.

People can be encouraged to abandon unscientific beliefs by making use of other beliefs. For example, religion was used in a successful educational campaign to promote rat control in Malaysia. Farmers believed that rats would take revenge upon their dead friends by causing worse damage. Citations from the Koran such as "The more rats you kill, the more you will be rewarded in Heaven" and "As a Muslim, it is sinful to be superstitious" were used by religious leaders in Friday prayers, in leaflets and on radio spots.[24]

The environmental message can be more successful where traditional structures and activities are used for social communication. These include peoples assemblies, discussion groups, religious groups, women's organizations, trade unions and political parties.

Maintaining sustainable activities in the long run demands that environmental knowledge should be transmitted and built upon in the future. Coming generations must be environmentally literate. Environmental education and training should exploit the traditional systems of transmitting knowledge. The incorporation of environmental knowledge in the community's culture is the best way to ensure that a communitys activities are sustainable.

[24] FAO: *A summary of the process and evaluation results of the strategic extension campaign of rat control in Malaysia*, Evaluation Report SEC No. 2 (Rome, Aug. 1987).

PART III

THE SALIENT CHARACTERISTICS OF ENVIRONMENTAL TRAINING

Environmental training should ideally cover a large variety of jobs and occupations, but there are certain features that all environmental training should incorporate. The planning and implementing of environmental training programmes can be made more effective if these common features are identified. First, environmental training should be multidisciplinary, acknowledging the complexity of the interactions between environmental phenomena and human activities. Second, the promotion of an environmental ethic must be an integral part of any environmental training programme. Programmes must also take account of the need to resolve situations of conflict over environmental issues, and of the often inadequate skills and knowledge of prospective students. These issues are discussed in this chapter.

A

The multidisciplinary nature of environmental training

Different sciences are needed for the analysis of environmental systems – ecology, meteorology, physics, chemistry, geology, oceanography, etc. However, mastering these sciences is not sufficient for environmental protection. Scientific knowledge about the environment must be complemented by knowledge about the human activities that can cause ecological disasters and about ways to reduce the likelihood of such disasters. In other words, environmental protection needs a blend of hard and human sciences.

The environment is composed of a variety of systems – ecosystems, atmosphere, hydrographical systems, etc. – and a network of interactions between them. To take an example, the dynamics of the atmosphere depend on factors such as topography, because mountains can stop the wind; latitude, which determines the amount of solar light; ocean currents, which transport heat; plants, because their evaporation modifies humidity. Landscapes are modelled by wind and rain, and transformed by living organisms. Ocean currents are influenced by wind and sunlight. Plant life depends on solar light; water and salts; soil characteristics; temperature, humidity; topography; other plants, animals and micro-organisms, etc. Animal life depends on plants; other animals; micro-organisms; temperature; water and salts; topography; soils

characteristics, etc. Soil characteristics depend on geological factors; hydrological factors; plants, animals and micro-organisms, etc. Each environmental system is integrated with all the others. It is therefore impossible to understand the structure and dynamics of an environmental system without understanding its relationships with the other systems. Box 2 illustrates how the command of different sciences is essential for understanding and controlling a pollutant.

Box 2

Sciences that are necessary for analysing and controlling a pollutant

Building up knowledge about a pollutant, its effects, and possible solutions requires integrated knowledge from various technical and scientific disciplines:

- engineering and chemistry to study how the pollutant is produced;
- meteorology and hydrography to study how it is transported by air or water;
- chemistry and physics to analyse the physical and chemical reactions during the transport;
- eco-toxicology, physiology, cytology, molecular biology and pathology to analyse the effects on living organisms;
- ecology to study the effects on ecosystem;
- medicine, economics, sociology and psychology to study the effects on economic activities, human health and quality of life.

Solutions may involve reducing polluting emissions by means of filters (end-of-pipe strategy) and/or reducing emissions of the pollutant (preventive strategy). The implementation of either strategy requires engineering and physical and chemical analysis. Determining the cost requires economic analysis. Convincing the producers to implement the solutions requires political skills. Environmental legislation is needed for drafting and enforcing environmental laws.

The diversity of sciences involved in dealing with the environment determines the need for different scientists to participate in environmental protection activities. However, it is not easy to organise multidisciplinary teams. Communication between researchers working in different sciences tends to be difficult. Their approach, interests and conceptual frameworks are all different. They use different theories. Each science has its own jargon, methodology and history; frequently it will be taught in an independent department, research will be carried on in a special centre and results will be published in a specialised scientific journal. This compartmentalization contributes to the lack of communication between the sciences and makes it difficult to set up multidisciplinary teams.

Multidisciplinary working also presents a challenge for environmental training. There is always the risk that training will merely convey to the student a large quantity of unorganized information. Environmental training should not constitute an appendix of information coming from various sciences but a well-organized set of learning activities that helps students develop their capacity to understand and manage complex environmental systems and their relationships with human activities.

The integration of social sciences into a coherent, mutually supportive, multidisciplinary environmental training programme is another source of difficulty. However, some training programmes have managed to integrate both social sciences and the other scientific disciplines. A good example is the Programme for Post Graduate Studies in Environmental Engineering, developed by the European Polytechnic Environmental Association and the Federal Polytechnic School of Lausanne, Switzerland with the participation of various training institutions that share their training capacities.

The programme includes 18 weeks' basic training, eight weeks' specialized training, and 15 weeks' research activity. The basic training includes scientific topics such as soils, the hydrological and atmospheric systems, the mechanisms of diffusion and concentration of pollutants in soil, toxicology and eco-toxicology. These topics are complemented by others such as the environment and health, environmental economics, environmental law, environmental impact assessment and environmental monitoring using photos and satellite pictures. The specialized training includes topics such as public sewage systems, public waste disposal systems, data banks for environmental data, multicriteria support for decision-making and negotiations, and the organization of multidisciplinary studies.

1. The complexity of interactions between environmental phenomena and human activites

Professionals who undertake environmental protection work must be able to understand complex systems, the causes and effects of environmental phenomena, and their interaction with human activities. This requires systematic training.

Human beings, like all other organisms, need a continuous uptake of matter and energy from the environment. They need to drink and eat in order to obtain water, salts, energy and matter for growth and rebuilding of the organism and maintenance of its functions. They also need matter and energy for clothing, building houses and producing goods. They extract energy and raw materials from the environment and dispose of waste and energy to it. The environment is the source and the repository of the matter and energy that people use in their activities.

A series of environmental processes begins when the effects of human activities are not balanced by the environment and may change its structure and dyanmics. Ecosystems, soils, the atmosphere, hydrographical systems, etc., may undergo local and global transformations as a result of human activities leading to environmental degradation.

The effects of interactions between human activities and the environment are difficult to foresee because:

- Environmental transformation is not linearly related to its causes. If the impact of human activities goes beyond certain thresholds a "cascade" of processes begins.
- Negative effects can appear at a great distance from their source. For example, acid rain is caused by pollutants generated thousands of kilometres away.
- Causes have a synergy. An example is desertification, caused by a combination of "mining" of forests, intensive agriculture, and reduction of water surfaces. These phenomena lead to changes in climate owing to reducing air humidity; depletion of soils occurs as soils lose their vegetal protection and are washed away by rain. Changes in soils and climate cause irreversible environmental transformation.

for example the disappearance of species, and ultimately the transformation of the ecosystem, which jeopardizes human activities.

- Environmental processes have global and local dimensions. The green-house effect and atmospheric and oceanic changes are global phenomena. Pollution of small bodies of water and accumulation of waste are local phenomena.
- Negative environmental processes can be reversible, such as clearing small areas of forest, or irreversible, such as the disappearance of species.
- Environmental systems are linked with each other, so one element will be part of two or more environmental systems.
- The borders of environmental systems are not easily defined.

The complexity of interactions between environmental phenomena and human activites must be taken into account in environmental education. A successful strategy was used by one of the authors in training Italian teachers.[25]

Course participants were encouraged to analyze the manufacture of a product, looking for the relationships between productive activities and environmental processes. A "conceptual map" was prepared to illustrate the relationships between human activity and the environment.

For example, a pen is made of metal and plastic. The metal is obtained by mining, using metal tools and energy, and transported in trains to factories. The manufacture of mining tools requires metal, which is obtained through mining, and energy, which is obtained using oil, millions of years old.

Mining and oil extraction and consumption generate negative changes in local and global ecosystems. This kind of qualitative analysis can be extended to many environmental systems. This strategy makes it possible to integrate the teaching of different disciplines such as geography, economics and ecology.

[25] Gagliardi, R.: *Training teachers for complexity* (forthcoming).

B

Towards an environmental ethic

Without responsible environmental attitudes and practices based on a new environmental ethic, no amount of environmental training will ensure a safe, healthy and sustainable environment. At the same time, purposeful environmental training is an important tool in promoting this ethic.

Past and present environmental change induced by human beings is so great that the environment cannot absorb further changes without causing irreversible damage and increasing the likelihood of environmental disasters. It is, for example, claimed that global warming will generate increasingly frequent destructive storms, melt the polar ice caps, raise sea levels and flood coastal areas. Avoiding these apocalyptic scenarios is an ethical objective.

The shift of emphasis from corrective to preventive environmental policies – that is, policies to prevent pollution and environmental degradation at their source – calls for changed attitudes and practices on the part of producers and consumers alike. Companies must incorporate environmental objectives into their strategic objectives, introduce environmentally sound production, distribution and waste disposal/reduction practices, and motivate their staff to carry them out scrupulously. Public authorities must develop sustainable and efficient transportation policies that save on energy and reduce pollution. Consumers must change their consumption patterns in order to reduce waste and the use of non-renewable natural resources. A new environmental ethic may induce changes in entire life styles in support of a sustainable environment.

An important issue is whether the environmental ethic should promote the natural environment or take an anthropocentric, person-centred, view of the environment and its protection. According to the former view, people should endeavour to protect all living creatures, even at the cost of inflicting some hardship on humans. This is the philosophy of "deep ecology", advanced by some radical environmental movements. The authors consider it to be incompatible with the objective of promoting a sustainable and healthy environment. Worse, it can justify human rights abuses and exacerbate economic inequalities. In the author's view, environmental ethics should instead be centred around

satisfying peoples needs in a sustainable manner. This may imply that the "natural" environment gives way to cultivation, industrial use or any other human activity, provided that the human interference is sustainable, promotes a better quality of life, and does not engender environmental degradation. Improving people's living conditions and avoiding environmental disasters and degradation are two aspects of the same objective. Sustainable development means avoiding environmental degradation. A person-centred ethic is therefore an environmental ethic.

An environmental ethic is also conducive to the promotion of human health and happiness through measures to reduce environmental degradation. A transport policy that reduces the use of private cars can be expected to improve general environmental conditions while also contributing to better public health.

1. What does an environmental ethic involve?

a. Collective action

An environmental ethic must promote collective action. Avoiding negative effects on the environment through individual action is a necessary but insufficient step towards protecting the environment. To be effective, individual action should be undertaken within the scope of collective measures. Collective action can help avoid conflicting individual activities. In some cases only collective action is effective. Rice farmers in Java (Indonesia) can maintain effective and environmentally sound pesticide control only by acting collectively and in an organized manner. Similarly, sustainable agricultural practices by farmers in Bali (Indonesia) can only be maintained through collective action. Following a precise timetable according to religious tradition, each farmers activity is closely integrated with the activity of other farmers.[26] This maximizes output year after year. Because of economies of scale, collective action is also more cost-effective than individual initiatives. Thus, collective

[26] John Reader: *Man on Earth* (Penguin Books, London, 1990).

waste collection and recycling programmes are more cost-effective than individual efforts.

b. Local and international solidarity

Another important objective of an environmental ethic is to promote solidarity between population groups, economic sectors and nations. Since the environment has no political frontiers, effective solutions to environmental problems call for the participation of governments and populations of different countries.

c. Negotiated resolution of conflict

The use of resources may create conflicts of interest. Such conflicts should be resolved peacefully through a process of negotiation. It is only by having an environmental ethic that people and interest groups can negotiate solutions to conflicts.

d. Popular participation

An environmental ethic should promote popular participation in the formulation and implementation of environmental policies and programmes. As in most other areas, government acting alone will not be able to ensure their effectiveness. Environmental monitoring and surveillance activities demand the inputs of specialists and laymen in many domains. In monitoring emissions by chemical companies, in order to put pressure on the companies and triggering measures to eliminate pollution, for example, government action needs to be supplemented, and if necessary replaced, by popular action. Environmental policing efforts by an environmental organization in Sweden provide a good example of the merits of popular participation in this area.[27] These are described in some detail later in this Chapter.

[27] Miljöcentrum: *Training for environmental law enforcement: The role of the NGO*, Training Discussion Paper no. 105 (ILO, Geneva, 1993).

2. The role of training

Promoting an environmental ethic is perhaps the ultimate objective of any environmental training activity. In fact, it permeates all the schemes, programmes and courses described in this Report so far. However, emotional appeals – often the main element of environmental education programmes – are inadequate in promoting an environmental ethic, which involves changes in values and the reordering of individual priorities. Environmentally sound attitudes must be supported by an understanding of environmental issues and a command of the methods and tools needed to manage the environment. Without this knowledge and mastery, the causes of environmental degradation cannot be understood nor can positive action be put into effect.

The following are examples of efforts to develop an environmental ethic among different target groups. We chose examples from the corporate sector because industries are major polluters: their adherence to an environmental ethic is likely to reduce environmental degradation significantly. We chose the schools because they reach a large part of the world's population and future workforce.

a. The corporate sector: Environmental guiding principles

"National professional associations are encouraged to develop and review their codes of ethics and conduct to strengthen environmental connections and commitment" (*Agenda 21*, Chapter 36.15).

National and international organizations, including trade groups, industry associations and citizen groups, are developing and drafting lists of *environmental guiding principles*. These are important instruments for the spread of an environmental ethic among their members and target audiences.

The International Chamber of Commerces (ICC) Business Charter for Sustainable Development

The ICC Charter was developed in response to *Our Common Future*, the report of the 1987 World Commission on Environment and Development

(Brundtland Commission) and reflects the input of environmental managers from major companies and industry associations in Europe and North and South America. The Charter can be expected to have a major impact in spreading an environmental ethic among managers and staff in the corporate world, since many of the worlds leading companies are members of the ICC.

Adherence to the Charter is entirely voluntary: the ICC simply calls on businesses to express their support for it publicly, and to use it as a basis for efforts to improve their environmental performance. The ICC Charter emphasizes the importance of establishing appropriate management structures. It recommends that environmental management be among the highest corporate priorities; that policies, programmes and practices be established to support this goal; and that these should be integrated into all the enterprise's functions. It then gives broad guidelines for the prescribed policies, programmes and practices. As far as *employee education* is concerned, it calls on businesses to "educate, train and motivate employees to conduct their activities in an environmentally responsible manner".

Boston, USA: The CERES principles

The CERES principles provide another example of environmental guidelines in the corporate sector. They were developed by the Coalition for Environmentally Responsible Economies (CERES), an organization of environmental groups and institutional investors based in Boston, USA. CERES believes that by linking its members' investments to a company's acceptance of a set of common environmental principles, they will provide an incentive for companies to improve their performance. Japan: The Keidanren Global Environmental Charter

Similar initiatives abound in other countries too, both at national level and on an industry sector basis. In Japan, the Keidanren (Japan Federation of Economic Organizations) Global Environmental Charter gives its more than 1,000 members a framework within which to develop environmental programmes on a voluntary basis. Although similar to the ICC Charter in emphasizing the importance of management systems, the Keidanren Charter puts more stress on community involvement and corporate citizenship. Companies are urged to provide technological and other assistance in case of environmental accidents, even when the company is not involved.

Canada: The CPPA Responsible Care Programme

The Canadian Chemical Producers' Association's (CCPA) Responsible Care Programme is a comprehensive mandatory programme for environmental responsibility among CCPA members. The CCPA has developed codes of practice for all major areas of activity in the chemical industry.

b. Promoting an environmental ethic in schools

In Lombardy, Italy, in 1989-90, a pilot project in secondary schools trained teachers to analyse their senior students beliefs and devise new approaches to environmental education. The ultimate objective was to enhance students knowledge of the environment and to develop an environmental ethic. A new approach was developed which integrated different disciplines, helping the students to change their simplistic and often erroneous ideas about humans and the environment, and to develop responsible attitudes towards the environment. The training centred around an understanding of the concept of territory and the devising of integrated solutions to social, political and environmental problems.[28]

In Belgium, as described in Chapter 2, some secondary schools have organized a programme whose aim is to develop an environmental ethic among the students. The students learn to monitor water quality in their neighbourhood, communicating their results to local and national mass media. The programme promotes an understanding among students that *collective action* is a prerequisite for successfully monitoring and protecting the environment. By analysing the possible impact of their activities on the environment, the students develop ethical attitudes towards the environment instead of basing their behaviour on immediate gratification.

[28] Raul Gagliardi et al.: "Analyse des conceptions sur le rapport homme-environnement des élèves de lycées de la Lombardie", in *Actes des XIIIèmes journées sur la communication, l'éducation et la culture scientifiques et industrielles*, (Chamonix, 1991), p. 571.

C

Environmental protection: Managing situations of conflict

Major infrastructural developments, such as the construction of a motorway, an airport or a dam, bring in their wake both economic and environmental costs and benefits, which affect different groups of people differently. Some benefit economically while others pay the costs in terms of reduced incomes and employment and worsening environmental conditions such as increased noise, lack of water for agriculture and traffic congestion. Likewise, environmental protection measures have an impact on economic activity, employment and incomes and affect certain industries, communities and population groups more than others.

Because they affect the interests of different individuals, population groups and industries differently, major infrastructural developments and environmental protection measures bring in their wake conflicts of interest. An important task of environmental training is to promote among decision-makers and the general public an understanding of the political and social dynamics of environmental protection and to develop the negotiating skills necessary for solving any conflicts that may arise. Such training should empower managers, employers' organizations, trade unions, citizen groups and individuals to defend their own interests. Training should convey an understanding of the economic, social and environmental issues involved, an appreciation of the interests and viewpoints of the other people and groups around the negotiating table, and a respect for the democratic negotiating process as a method of resolving conflicts. As in all human affairs, imposed solutions tend to be unsustainable, as they generate resistance and ultimately fail to achieve their intended objective.

The rest of this section looks at environmental organizations, and the training and skills that they must possess in what is sometimes called the "environmental pollution battlefield", and at the trade unions, and the training

they need to empower them to participate in resolving environmental conflict situations.

1. Equipping environmental organizations for the environmental battlefield

The environmental battlefield is a somewhat provocative term for the process by which citizens – who have the ultimate responsibility for protecting the environment – act as environmental police to ensure that governmental agencies are enforcing environmental legislation adequately and that industry is complying with the legislation. In fulfilling this responsibility, citizens have often established environmental organizations. These organizations are often in a situation of conflict with both industry and the regulators. In the experience of one such environmental organization – Miljöcentrum in Sweden – a "partnership-type" relationship tends to develop between the regulators and the polluting industries that they are supposed to regulate.[29] In this partnership, the regulators may offer more protection to the polluting industries than to the environment. Generally, it appears that the regulators are unaware of – or, more likely, simply choose to ignore – the potential of existing pollution control equipment.

This apparent conspiracy between *regulators* and *regulated* has forced Miljöcentrum to construct both a *first* and *last line of defence* in the battle to protect the environment. According to Miljöcentrums Director, Björn Gillberg, the first line of defence is for environmental organizations to educate people about existing and potential dangers to the environment. They must also inform the public about the sort of environmental legislation that is required to deal with these problems. Using this information, people can apply pressure both at the ballot box and in the market place.

The last line of defence is for environmental organizations to act as police to ensure that the regulators are enforcing environmental protection laws. In this role, the organizations will need to appear at administrative hearings and present arguments to counteract the proposals made by industries. They must also, when necessary, be prepared to take the industries and/or the regulators

[29] Miljöcentrum, op.cit.

to court. Legal and negotiating skills are valuable assets for such activities, and can be sharpened by specific training programmes.

a. The scope and nature of environmental information

Environmental organizations use multiple means to provide information to the public. They answer requests for information from individuals and groups, hold seminars and lectures, write articles and press releases, appear on radio and TV. There are two sides to this activity of disseminating information: first, educating the public about topical environmental issues; second, suggesting alternative, environmentally sustainable solutions to the problems raised.

To be able to do this, and also to confront a wide range of industries, if necessary in court, environmental organizations need the knowledge, skills and training to identify industrial pollution and its effects on the environment and human beings. They must then educate the public to understand and exploit this information for use in the negotiating and decision-making processes. Environmental organizations must ensure that the information they provide to the public is accurate.

Table 2 tabulates the information – and by implication the knowledge, skills and training – required to characterize pollutants and their sources, and their effects on the environment and on human beings.

The first column shows the different types of industry that environmental organizations may have to confront. The second column shows what information is required to characterize pollutants properly. The third column relates to the mechanisms for the spread of pollutants in the environment. The fourth and fifth columns are concerned with the physical and/or biological effects of pollutants. Some of this information will be collected by the environmental organization itself, while other parts of the data collection and measurement work will be contracted out to consultants with the necessary equipment and expertise.

It is essential that information under each of these heads be considered in the analysis of the potential environmental effects of any pollutant. For example, if a city suffers from smoke generated by coal burning by surrounding industries, the city could attempt to solve the problem by increasing the height of the chimneys. The smoke would then come to earth downwind of the city and would be less concentrated. However, the higher chimneys – a typical

Table 2: Nature, sources and effects of industrial pollution

INDUSTRIES	SOURCE DESCRIPTION	DISPERSION	EFFECTS	
Manufacturers	TYPE	Atmosphere	Physical	Biological
Electricity generation	Point	Groundwater	Global	UPTAKE by
Refineries	Volume	Surface water	Climate change	Plants
Petrochemical	Line	Ocean	Ozone depletion	Animals
Chemical	Product	Distribution	Acidification	Humans
Pharmaceutical	EMISSIONS to		LOCAL	EFFECTS on
Mining	Air		Smog reactions	Plants
Smelters	Water		Property damage	Animals
Agriculture	Ground		Soil erosion	Humans
Food processing	NATURE of the POLLUTION			
Forestry	Chemical composition			
Pulp and paper	Physical properties			
Waste disposal	Radioactivity			
Transportation	Particle size			

Industries that Miljocentrum has challenged in Licensing Board hearings or in court proceedings.

example of a corrective environmental protection measure – would only solve part of the problem. The emissions from the chimney would still contain the compounds that produce acid rain and the carbon dioxide released into the atmosphere would still promote climatic change by augmenting the greenhouse effect.

An important aspect of educating the public and helping it develop its negotiating position in the environmental battlefield is to convey the concepts of reversibility versus irreversibility. When environmental change is reversible – which means that the environment can sooner or later be brought back to its original condition, with or without corrective measures – there is often room

for flexibility and trade-offs in negotiations. But if the change is irreversible – as when an economically or medically valuable species disappears – there is no room for negotiation.

2. Preparing trade unions for environmental decision-making

In their work, people have a continuous impact on the external environment. At the same time they – and their families and the communities in which they live – are exposed to the effects on the environment of the enterprises activities. Workers and their unions are one particular group in society that needs environmental knowledge and negotiating skills in order to be able to defend their interests and participate fully in decision-making that has a bearing either on their immediate working conditions or on the wider environment.

Traditionally, trade unions have actively stressed their right to take part in decisions that affect their members conditions of work. The focus has been on the immediate working environment, primarily within the walls of the enterprise, and the health and safety aspects of work have tended to loom large. In many countries, workers and their representatives work with their employers in health and safety committees. Health and safety issues are often integral elements in collective bargaining negotiations and agreements between the social partners.

In recent years, there has been a general rise in environmental awareness, which has not bypassed the trade union movement. In fact, many trade unions are pressing to expand the brief of health and safety committees to incorporate general environmental issues and their local and global implications. International and national trade union organizations – for example the International Confederation of Free Trade Unions (ICFTU) and the European Trade Union Confederation (ETUC) – have prepared detailed environmental policy statements that transcend their traditional policies on employment and working conditions. Some national trade union organizations have done the same.

a. Putting environmental issues on the collective bargaining agenda

"Trade unions and employers should establish the framework for a joint environmental policy, and set priorities to improve the working environment and the overall environmental performance of enterprise". (*Agenda 21*, Chapter 29.10).

In some countries, efforts are made to incorporate environmental issues into the collective bargaining process betweeen the social partners. The United Kingdom's so called Green Agreement is a recent example. In the developing world, the ILO has been actively encouraging its constituents to put environmental issues on the collective bargaining agenda. The ILO has organized a number of regional and national training workshops to raise trade union leaders awareness about environmental protection issues, to sharpen their negotiating skills, and to enable them to formulate their own environmental policy. The ILO is also preparing a manual on some salient environmental issues that trade unions will be able to use as a tool in negotiations and in training their members.[30] Similar developments are taking place in Italy, under the auspices of the CGIL (Confederazione Generale Italiana del Lavoro), one of the countrys largest trade union organizations. The courses organized by the CGIL are described in Chapter 5.

United Kingdom: A model Green Agreement

In the United Kingdom a model Green Agreement has been drawn up. The aim is to encourage unions and employers to sign an agreement recognizing that structured discussions between management and union reprsentatives are essential to the success of their joint environmental strategy. Higher environmental standards would also present an opportunity to improve quality and efficiency.

The model agreement recommends that the social partners should take part in the official joint health and safety committee, or any other joint body as agreed by both signatories. The parties would agree that decisions about environmental action must be based on accurate information and that audits of existing operations and impact assessments of proposed operations are an essential tool in making such decisions. Although any environmental strategy needs to be flexible enough to cover the different opportunities and challenges facing employers, the signatories would agree that the following issues must be addressed:

[30] ILO Project Workers' Education and the Environment (INT/89/M04/NOR).

- the environmental impact of the employers current and proposed activities, ranging from the workplace and its surroundings to the international level;
- waste or by-products (liquid, solid or gas) from the employers operations;
- products and raw materials used by the employer in the course of the companys activities;
- the disposal and recycling of products at the end of their working life;
- challenges and threats to the employers activities from legal, economic and other similar developments;
- opportunities presented by new products, processes and services, as well as competitors' efforts to exploit such opportunities;
- action by employer or union to influence public debate on environmental issues.

Training and education

According to the model agreeement, both union and employer representatives must have a good working knowledge of environmental issues. Employers must agree to co-operate with attempts by union representatives to gain knowledge and receive training about the issues under discussion; they must also ensure that managers receive appropriate training. Such co-operation could include:

- paid time off for union representatives to attend training courses;
- financing training for both parties representatives;
- working with experts to advise both parties' representatives and to inform the workforce;
- producing material for employees which would outline "green" threats and opportunities for the employer;
- developing an information campaign aimed at persuading the local community, the media and the regulatory authorities that the employer is taking its environmental responsibilities seriously.

[1] CEDEFOP: *Training and Environment*, Synthesis Report (Berlin, Dec. 1992).

An example of efforts in this direction is provided by the 1991 joint recommendation of the social partners in Belgiums chemical industry that information and training on environmental issues directly related to the enterprise should be given to workers and their representatives at all levels.[31]

D

The skills and knowledge of students entering environmental training programmes

Research carried out in many countries, for example, France, Italy, Spain and Switzerland, suggests that trainees on environmental training programmes often lack certain basic skills and knowledge needed for environmental protection work. Despite the fact that these subjects are studied in secondary schools, school leavers often lack a basic understanding of the concept of energy, the process of energy transfer, the structure and cycle of matter, the characteristics of living organisms, the relationships between human activities and ecological phenomena.

School leavers often do not understand complex systems or relationships, such as ecosystems and human societies, and they tend to think linearly, although environmental phenomena occur in a non-linear manner, in a complex web of causality. Preoccupied with themselves as human beings, many regard the environment solely as a source for the gratification of their needs. They tend to have a limited understanding of the causes of environmental degradation, often believing that domestic waste is the most important pollutant. Many lack a clear perception of how waste is transformed in the environment, and regard recycling as the solution to every problem.

Secondary schooling thus does not automatically guarantee that students have the analytical and conceptual background necessary for engaging in environmental training programmes. Before starting environmental training, it is necessary to assess the knowledge background of trainees and their capacity

to understand complex systems. For this reason it may be necessary to integrate some basic science education in environmental training programmes. In the long run, reforms may be considered that will strengthen environmental science education in schools.

Secondary school leavers and university graduates often agree that they lack the background necessary for doing environmental work. One solution may be postgraduate courses on environmental protection organized by trade unions, private enterprises, regions, provinces and municipalities. These courses may meet training needs that are not covered by schools and universities. In Italy, for example, informal environmental training is complementing regular school programmes.

But the need for environmental competence cannot be met adequately by organizing informal courses. The conceptual tools and understanding of environmental issues must be developed at the compulsory school level. Effective environmental training requires fundamental education reforms. Teams of researchers, teachers and members of environmental organizations are working on this issue. Flexibility and adaptability should be the key characteristics of young people's background to help them adapt to a changing environmental labour market.

PART IV

ENVIRONMENTAL TRAINING: INSTITUTIONAL STRATEGIES AND METHODS

As with most training, the institutional framework, the approaches and the methods used in environmental training tend to differ according to countries' traditions and established training practices. Environmental training is new to most established educational and training institutions, and many have been slow to respond to emerging labour market demand for environmental skills and competencies. Because of this inertia, many environmental training programmes are organized outside the formal educational systems. Enterprises, private initiatives and co-operative ventures have often been more innovative and flexible in mobilising the resources required for environmental training. Environmental training tends to be complex and difficult and requires considerable investments in the formulation of training objectives, course content and methodologies. For example, training must develop the skills required for collecting environmental data, and it must also engender sufficient understanding of environmental phenomena and the relationships between them for trainees to interpret the data.

The choice of institutional strategies and methods for delivering such training is considerable, including institution-based and classroom training, practical hands-on training, practical training combined with theoretical instruction based on the dual system model, and enterprise-based training. Possible providers of environmental training include schools, training institutions, enterprises and the mass media. Training can be teacher – or learner-centered, use a problem-solving method, or take a territorial approach. It can also make use of open and distance learning and computer-assisted methods. Finally, environmental training must take into account learners' conceptions about the environment. The choice of institutional strategies and modes and methods of environmental training are discussed in this chapter.

A

The choice of providers and modes of training

1. Providers

If environmental education and training is to reach everybody, it should be delivered through different institutions, such as schools, enterprises, com-

munity organizations, trade unions and the mass media. Each institution can then focus on those areas where it has a comparative advantage. Particular institutions tend to have particular target audiences, which other institutions are less well placed to reach. The broadest audience belongs to the mass media, which can be used to inform the public about environmental issues and ways of solving environmental problems. Schools are in a good position to instill basic scientific concepts, the learning of which demands sustained effort over a long period of time. Training institutions can best develop occupation-specific environmental knowledge and skills. Enterprises can often provide environmental training tailored to the job. The natural clientele of trade unions are their members. Community organizations and NGOs, often active at the grassroots level, can educate members of the community, in particular women and informal sector workers. Finally, universities and other higher education and training institutions have the task of training environmental professionals.

These different training activities should complement and reinforce each other. For example, learning general environmental concepts at school can support more specific environmental training within the enterprise.

2. Training modes

Training modes should be adapted to the objectives and characteristics of the training programme and the target audience.

A salient characteristic of training for environmental protection is the necessity to maintain close contact with the actual environment. Purely theoretical education is insufficient: environmental competence must also be promoted through observation, experimentation and practical work. A combination of theoretical and practical training is therefore necessary. Another essential element of environmental training is the promotion of collective and team work. Environmental issues and activities are by their nature multidisciplinary and need the participation of people with different scientific and technical backgrounds. This means that if classroom education and distance learning methods are used for environmental training, they should be complemented by practical hands-on-activities.

It is particularly important for the training of environmental professionals, such as ecologists, environmental engineers, advisers and eco-toxicologists, that the acquisition of scientific knowledge should be integrated with professional skill training. Monitoring the use of renewable natural resources such as fish, for example, calls for knowledge about ecosystems, oceanography,

population dynamics and statistics. This knowledge must be integrated with practical skills such as determining the size, weight, and age of the fish and the salinity and other chemical and physical characteristics of oceans.

a. The target audiences

The characteristics of the target audience are another important element in determining the mode of training. Classroom education, often adequate in school programmes, is less so for people engaged in, say, informal sector activities. Here on-the-job training is more effective, giving people the possibility of improving their incomes by engaging in new activities such as product and waste recycling, which also benefit the environment. Community-based training is a necessity when, for example, farmers' pest control activities need to be co-ordinated in order to ensure the intended results.

The choice of training mode must also take account of the daily schedules and routines of individual participants. For example, training activities for women must fit in with their family activities, and child-care may need to be provided so that women can be released for training. The themes and content of training must also be relevant to the target audience and the choice of mode must take into account the theme of training. For example, training illiterate farmers to use less pesticide is best done in the field, showing them the potential of the new farming methods. On the other hand written information may be adequate to convince professionals to adopt the new methods.

b. A lifelong learning process

Finally, environmental education and training should be seen as a lifelong learning process. All human activities have an impact on the environment. It is therefore necessary, to mobilize various providers of environmental education and training at different phases over a lifetime.

Pervasive technological change continually challenges environmental training to adapt its educational priorities, programmes, modes and methods. New technologies often have a novel impact that require innovative responses, including training. The increasing use of new technology in environmental work necessitates training for those who are to operate it.

Social change – for example population growth, urbanization and changing consumption behaviour – also transforms the environmental impact of human activities. Environmental education and training should therefore be continuously updated to take into account social change and the new environmental challenges presented by it.

B

Methods of environmental training

Experience and research suggest that some educational methods are more effective in environmental education and training than others. In addition to being multidisciplinary, methods should be learner-oriented, using problem-solving techniques, stimulating individual initiative and creativity, emphasizing participation, co-operation and teamwork, and promoting curiosity about the environment. It is also important that training methods should encourage the development of decision-making skills.

As discussed in Part III, research in many countries suggests that secondary school students do not learn much about environmental concepts at school. One barrier to learning environmental concepts is that former, often erroneous, conceptions need to be corrected. Without motivation, students will not learn these new concepts. The major problem is that education is strongly teacher-centred. Teachers decide what students should learn and how they should learn it. Teachers put forward problems and solutions that may not be relevant for the students. The latter do not participate in deciding study subjects. This traditional approach does not foster decision-making skills, nor the motivation to participate, communicate and negotiate.

A *learner*-centred approach is more likely to stimulate creativity, autonomy and individual initiative while at the same time encouraging team working and decision-making. Learning should not be imitative: it should stimulate the learner's capacity to identify and solve problems.

Table 3 summarizes some institutional strategies and methods for environmental education and training.

Table 3: Institutional strategies and methods for environmental education and training

Educational aspects	Traditional education	Education for sustainable development
Institutional strategies	• Limited period of education continued to schools	• Life-long process, open to the community
	• Single channel education, school-based	• Multiple-channel education (school, companies, media community, level organizations)
	• Centralized education at national level	• Decentralized units with increased academic, managerial and financial autonomy
	• Education largely controlled by teachers' unions	• Education progessionally conducted by academic councils and individual teacher specialists
Methodological approaches	• Teaching-oriented and teacher-centred	• Learning-oriented and student-centred
	• Respect for hierarchies	• Stimulation of individual initiative and creativity
	• Unidisciplinary approach	• Multidisciplinary approach
	• Emphasis on individual competitiveness	• Emphasis on participation, co-operation and group competiti veness
	• Imitative education	• Discovery and problem-solving education

Source: Luis Albala-Bertrand: op.cit.

1. Some successful environmental training methods

Below we illustrate some environmental training methods that have been found effective. One of these combines two strategies, the *situation-problem strategy* and the *systemic strategy*. The second uses a *territorial approach* while the third adopts an *action research approach*.

a. A combined approach

The simultaneous use of two strategies – a "situation-problem strategy" and a "systemic strategy" – is a new development for environmental education.[32]

The use of a situation-problem strategy helps the student learn to recognize problems both in the near environment (for example specific pollution, noise, management of space or resources) and in the global biosphere (for example overpopulation, desertification, deforestation), to identify their causes, and to determine what resources and activities are necessary to solve them. Students thus learn to identify and tackle problems in a real situation.

The systemic approach involves analysing the environmental problem as a series of dynamic processes. The analysis has three steps:

1. identification of the elements of the system and the laws that define their interactions;
2. analysis of the evolution of the system;
3. use of knowledge about the system in the search for alternative solutions.

The systemic approach allows students to learn to identify, put in hierarchical order and integrate the political, economic, social and ecological elements of an environmental problem. They also learn to analyse a process of environmental planning and management, and develop the capacity to understand the complex relationships between different environmental phenomena. The Laboratory of Didactics and Epistemology of Sciences of the University of Geneva is using both these approaches in environmental education activities organized around the analysis of different environmental problems: a waste-burning site near food industries; a big building site that has adverse effects on village activities; an open-cast mine that changes the landscape; an illegal but accepted waste disposal site, and animal farms that pollute rivers.

b. A territorial approach

A student who follows an environmental education programme should learn different disciplines at a high level and be able to integrate them. But there is always the risk that training will merely convey to the student a large quantity

[32] A. Giordan and C. Souchon: "Quels outils pour une éducation pour l'environnement", in *Actes des XIIIèmes journées sur la communication, l'éducation et la culture scientifiques et industrielles* (Chamonix, 1991), pp. 221-228.

of unorganized information. Environmental education should not constitute an appendix of information coming from various sciences but a well-organized set of learning activities that helps students develop their capacity to understand and manage complex environmental systems. Chemistry, physics, thermodynamics, mathematics, statistics, biology and ecology should all be integrated in the student's mind and used for understanding environmental processes. Concepts such as energy, entropy, molecule, chemical reaction, respiration and photosynthesis should be integrated with concepts such as cell, organism, self-building, micro-organisms, species, population, ecosystem, economic activity and territory. Box 3 elaborates on the difficulty of integrating concepts used in different disciplines.

Box 3

The difficulty of integrating concepts used in different disciplines

Education research shows that secondary school students do not spontaneously integrate concepts that are taught in different courses. In a student's mind, the energy learned about in physics is not the same as the energy learned about in biology or geography. Students do not use the concepts of molecule and chemical reaction learned in chemistry to explain biological or environmental processes. Yet the integration of concepts is as important as the learning of them. In fact, without integration the information is forgotten. This contributes to the rapid loss of scientific information learned by rote in schools.

Different disciplines can be integrated around a particular theme, such as the local territory or area. Studying the area where they live can motivate students and enable them to establish relationships between the human sciences (history, politics, human geography) and other sciences (ecology, geology, chemistry, physics, etc.). Each of these disciplines can focus on a particular aspect of the local area, but integrating the other disciplines.[33] For example, a history teacher can teach about the main historical processes, at the same time discussing associated environmental transformation, the geographical aspects, economic evolution, etc. The teacher of ecology can start with a description of

[33] Raúl Gagliardi et al.: "*Analyse des conceptions sur le rapport homme-environnement des élèves de lycées de la Lombardie*", pp. 571-575.

the main ecosystems in the area but can also analyse the impact of economic activities and the relationships with historical processes. Students must be stimulated to establish relationships between the different disciplines.

One advantage of this methodology is that it eliminates the isolated themes that so lack relevance for students. It shows how all the different areas of knowledge can be integrated and used to build new knowledge. One example of this approach is an environmental curriculum prepared in Italy,[34] which is organized around an analysis of the different resources of a region, the environmental impact of their exploitation in a given historical period, and the possible solutions for reversing environmental degradation.

c. *An action research approach*

A **Field manual for water quality monitoring**[35] illustrates an innovative approach to environmental training. It can be used by students, teachers and community organisations. Its objectives are "to assist citizens in the development of attitudes, knowledge and skills essential in helping to maintain and improve the water quality of our rivers throughout the world". The manual helps the reader to consider rivers and other water systems as a scientist but also as sociologist, economist, artist and politician. The manual is a tool for empowering people to undertake monitoring activities themselves.

The manual describes nine tests for measuring water quality. It also provides information about the sources of water pollution and the best ways of reducing it. It helps the reader to understand the implications the test results will have for human uses of the river. In one community, for example, a team of students discovered that one section of the river was unsafe for windsurfing, a common recreational activity there.

The manual illustrates an educational model known as *action research*. This involves, first, data collection to identify community environmental issues. The next stage focuses on solving problems and taking action. Students and teachers select some of the issues that they have identified for further in-depth study. When studying the river, the students collect data by testing the water.

[34] Bernardini Mosconi, P. and Gagliardi, R.: "Parco del Ticino, un instrument pour l'éducation à l'environnement", in *Actes des XVèmes journées internationales sur l'éducation et la culture scientifiques et industrielles* (Chamonix, 1993).

[35] Mark K. Mitchell and William B. Stapp: *Field manual for water quality monitoring – An environmental education program for schools*, Thomson-Shore, Inc. (Dexter, Michigan, 1991), fifth edition.

They also make notes about the thoughts, feelings, images, sounds and smells that strike them in their experience of the river and its surroundings. These scientific and informal observations often motivate the students to start identifying problems, proposing solutions and taking action to raise the quality of the water.

Action researchers become both learners and doers. They not only test rivers to determine their health, but also prescribe treatment or courses of action. They are also encouraged to inform community authorities and members about the results of their monitoring. This may increase public awareness and motivation to take action to improve water quality.

C

Taking learners' conceptions into account

Environmental training must be adapted to the conceptions and capacities of the learner. The learning process depends on a web of ideas, beliefs, logical abilities, language, knowledge and skills that individuals develop and use for integrating new information and building new knowledge and skills. This web is organized in a system called the *cognitive system*. It may facilitate the learning of some knowledge and skills, while hindering the learning of others. By identifying the hindrances to students' learning, teachers can design training programmes that help the students to overcome the obstacles.

Acquiring basic scientific knowledge is not easy. Listening to a teacher imparting scientific information is often inadequate for the building of new knowledge. The didactics of science, a new discipline, analyses the learning of scientific concepts and suggests methods for helping the learner. Its basic assumption is that learning is not a simple acquisition of new information. Rather it is a complex process of transforming conceptual frameworks. This means transforming the learner's beliefs and building new knowledge.

Learning obstacles can be affective, cultural, religious, logical or conceptual. Some of these obstacles are discussed in chapter 2. Here we will look at the difficulty people have in incorporating new information that goes against their existing beliefs. Overcoming this obstacle is fundamental to learning.

An analysis of students' conceptions can be integrated with different learning strategies and methods. It can be the basis for *learner-centred* courses, enabling the trainer to understand students learning problems. The trainer can also use students' conceptions as the starting point for training.

Individuals build their conceptions of the world by using their empirical experience and reproducing many of the ideas and beliefs of their community. On any given subject, people tend to have similar conceptions. This is confirmed by educational research in European and Latin American schools, which shows that conceptions differ little between countries. This homogeneity facilitates training. However, because there may be some differences between individuals, an analysis of existing conceptions must be carried out for each new group of students.

Students tend to find it difficult to change their conceptions. They are often able to repeat the information they are given, but do not change their conceptions and subsequently forget it. Providing scientific information without helping the students' change their existing conceptions is therefore useless.

Learners often develop erroneous ideas when they integrate scientific information without changing their existing conceptions. An example is the belief that plants take in food through their roots. In one course on plant nutrition, students integrated new information about photosynthesis with their previously held beliefs. This resulted in a new, false belief that leaves carry out photosynthesis and then fall to the ground, where plant roots eat them.

Another common false conception is that "mother nature" protects life. This conception hinders the understanding that the environment has no internal control and that human activities can have an adverse impact on the environment.

1. Structurant concepts

One way of helping students overcome false conceptions of the world is to focus training on a few concepts that will improve their capacity to learn and provide the basis for new knowledge by developing the capacity to perceive new phenomena, see new problems, and look for new solutions. These concepts are called *structurant concepts*.[36]

36 Raúl Gagliardi, "Les concepts structurants de la biologie", in *Actes des Vèmes journées internationales sur l'éducation scientifique et industrielle* (Chamonix, 1983).

Structurant concepts can be identified by analysing the history of science. Science does not evolve by accumulation of data. Scientific progress involves a series of conceptual changes followed by changes in research methodology. In other words, a conceptual change leads to new thinking, the identification of new problems and the development of new tools to solve them. The concepts that trigger major changes in scientific theory and research are known as structurant concepts. A few examples of structurant concepts are given in Box 4.

Box 4

Some structurant concepts for environmental training

- We can see lions, but not lion populations. Understanding the structurant concept of **population** requires training. This understanding makes it possible to undertake new environmental activities, such as environmental monitoring and management. Such activities require data about the structure and dynamics of different populations: number of individuals, age structure, birth rates, mortality rates, etc.
- The diffision of a pollutant cannot be fully understood without an understanding that air and water consist of molecules that are in continuous movement. When learners understand the concept of **molecular structure** they can comprehend that all matter is composed of molecules and that a chemical reaction is a molecular transformation.
- The concept of **micro-organism** is essential for understanding environmental processes, such as the transformation of organic matter into inorganic matter. It also helps the learner to understand that sewage has an environmental impact, since micro-organisms multiply in it. The concept is also useful for understanding the techniques of preserving food, preventing infectious diseases, etc.
- The concept of **energy transformation** is fundamental to the understanding of environmental processes such as photosynthesis (which transforms solar energy into chemical energy), combustion (which transforms chemical energy into heat) and ocean currents (caused, among other things, by differences in water density arising from solar heat).

PART V

TRAINING FOR MAJOR ACTORS IN THE ENVIRONMENTAL AREA

The key actors in the struggle for a sustainable environment are many. This chapter singles out for analysis training programmes focused on the needs of some of these actors, namely enterprises, governmental agencies, farmers, trade unions and their leaders, environmental trainers, women, and informal sector workers.

A

Environmental training and the enterprise

"...industry ... should include an environmental management component in all relevent training activities." (*Agenda 21*, Chapter 36.17)

"...industry... should promote an understanding of the interrelationship between good environment and good business practises." (*Agenda 21*, Chapter 36.20)

As producers of goods and services, *enterprises* have a major impact on the environment. Any environmental policy, and any measures that aspire to promote a sustainable environment, must solicit the support of the enterprise sector. In fact, "the onus of proving that sustainable development is feasible rests primarily on the private business sector, as it controls most of the technological and productive capacity needed to conceive more environmentally benign processes, products and services, and to introduce them throughout the world." [37]

More and more companies are integrating environmentally sound solutions into the production process. For example, Ciba-Geigy at its chemical factory in Monthey, Switzerland, is now recycling solvents used in making pigments. The enterprise is also regenerating and reusing catalyst metals such as mercury and zinc. These activities save on raw materials and energy and reduce the need for waste treatment. The factory is also processing waste,

[37] Peter Wallenberg: *Introduction to sustainable development: The business approach*, International Chamber of Commerce Publication 210/330 (Paris, Nov. 1990).

filtering, washing or destroying gaseous effluents by burning or absorption, purifying biodegradable liquids, transforming organic waste into minerals, incinerating non-biodegradable substances and processing used packaging materials. The factory also has dumps for mineral ash, which are monitored [38]

This section looks at the growth of environmental awareness in enterprises. It provides examples of how environmental training can be integrated into company staff training programmes. It shows that enterprises can act as environmental educators by raising public awareness about the environment and encouraging changes in consumer behaviour. Utility companies that promote energy-saving provide an example here. It also describes a procedure for designing environmentally sound production processes. Finally, it discusses the move towards total quality environmental management (TQEM), a tool to improve companies' environmental performance. TQEM implies a fundamental change in enterprise culture. [39]

1. Integrating environmental training into company staff training programmes

Germany: Integrated environmental protection training

A good example of integrating environmental issues into company training is provided by Asea Brown Boveri (ABB), the large group of companies operating worldwide in electrical engineering, communication and environmental technology. In its company in Germany, most training is in the new electrical and metal engineering occupations. Training develops core skills such as "independent action", "flexibility", "willingness to learn and learning capacity", "creativity", "ability to work in a team" and "responsibility sharing".

[38] ILO: "Green business and white smokestacks", in *World of Work*, No. 2 (Geneva, 1993).

[39] See e.g. Global Environmental Management Initiative (GEMI): *Conference Proceedings*, Corporate Quality/Environmental Management II: Measurements and Communications Conference, 16-18 March 1992, Arlington, Virginia.

There is also an environmental protection objective: to encourage environmentally sound behaviour both inside and outside the workplace.

ABB holds the view that environmental training should not be provided in the form of separate projects but integrated in ordinary day-to-day training activity. During the company's basic on-the-job craft training course which lasts one and a half years, environmental topics are taught following trainers manuals on **environmental protection** and **energy and environment**. These manuals go beyond the statutory training regulations. The company considers it imperative that its future employees should understand the process of energy production and its effects on the environment. Classes therefore cover basic knowledge about environmental protection and the rational use of energy as well as promoting sound environmental behaviour.

United States: Environmental training for company staff [40]

Companies in the United States are obliged to comply with a vast number of (sometimes conflicting) federal and state laws and regulations, the enforcement of which is becoming increasingly strict. Companies that violate them are brought to court and those – managers or other staff – found responsible have to pay fines and may even face gaol sentences. Under the Endangered Species Act, for example, even harassing (say, flashing a light at) an animal covered by the Act is punishable. In addition, companies must increasingly go beyond merely complying with the minimum environmental requirements as they face the spectre of liability lawsuits from environmental groups and local communities. Economic self-interest thus increasingly dictates that companies activities' should be environmentally sustainable. Many big companies invest large sums in compliance training – training to ensure compliance with all relevant legislation – and also in proactive training to sensitize *all* their staff to the imperatives of environmental protection. In addition, many engage in educational programmes aimed at the general public.

Environmental compliance training is vital for companies engaged in activities that are particularly environmentally sensitive. Arco and Chevron are both large, natural resource based companies engaged in oil extraction, refining and production. They put considerable resources into training their operative

[40] This text is based on the findings of an ILO mission to the United States, 1992.

staff (for example oil rig personnel) in order to familiarize them with the relevant environmental legislation, to develop operative, diagnostic and problem-solving skills in their daily tasks, and, extremely important, to invest them with a sense of responsibility towards their work. Oil rig operatives at Arco follow a two-week long course, the aim of which is to provide them with the environmental awareness and knowledge they need in their day-to-day work, so that they can, for example, manage a particular waste disposal problem and work with the relevant environmental professionals. Again, integration is the rule for this type of training. Rather than having a separate environmental course, the environmental issues and implications arising out of a particular activity or task are integrated into the general training programme. A modular interactive video training package is now being developed for operative oilrig personnel.

There is generally a two way flow of technical know-how and training in these large companies. Their *environmental professionals* are mostly trained away from the company's premises, attending higher education institutions and professional seminars and conferences. They are encouraged to attend engineering schools and universities in order to upgrade their knowledge and skills and to write papers for professional journals. Outside training resources are used to prepare staff to undertake environmental impact assessments, which are required when a company plans a new production facility. Firms' professional staff may also lecture in schools and community colleges and help plan college courses.

Environmental regulations also oblige Arco to ensure that relevant compliance training is given to its *contracting companies* and their staff. Either the contractor submits a training plan to be approved by Arco or Arco provides the training itself if the contractor cannot do so. This is what happens, for example, when the regulation 40 hours of occupational, safety and health training is given to workers who clean up hazardous waste sites under the HACWOPER programme. Project-specific training may also be used to sensitize oil exploration crews to the potential danger that their activities pose to endangered species, such us the desert tortoise in the Mohave desert in California, and to train the crews in the procedures necessary to protect the animals and avoid violation of the Endangered Species Act.

2. The company as environmental educator

California, USA: Promotion of energy-saving by utility companies

Under considerable pressure from state legislation and public opinion in California, two utility companies are pursuing innovative policies to encourage *energy-saving*. Instead of building new power stations to meet the burgeoning demand for energy, the bulk of the companies' investments are today going into energy *conservation* measures. Southern California Edison, operating in the southern part of the state (the Los Angeles basin) and the Pacific Gas and Electric Company in and around San Francisco are both strongly committed to energy-saving policies.

Air quality is the major environmental issue in the Los Angeles area and much of Southern California Edison's policy aims to reduce emissions through energy-saving measures. This means investing money and human resources in research and development, which benefits its own electricity-generating business – nuclear and hydro-electric plants, coal power stations, solar energy and wind power facilities. Southern California Edison has a virtual electricity monopoly in its catchment area.

Yet the company considers it equally important to promote energy economy among its customers. A number of quantitative indicators suggest that it has had a considerable *catalytic impact* on its customers' energy consumption. The company uses several instruments to encourage its industrial, commercial (everything from banks to restaurants) and domestic customers to use less energy. It offers incentives, for example subscription rate reductions and direct financial assistance to cover installation costs of energy-saving devices; it also gives low income households energy-efficient appliances and maintains them free of charge. The objective is to encourage customers to replace obsolete equipment with energy-efficient appliances.

The company also offers technical advice and training to customers who are keen to introduce energy-saving measures. The company is applying its expertise to find the optimal solutions to environmental problems before they reach crisis proportions. Chief Executive Officer John Bryson points out that

his company is entering areas that "traditionally have been none of its business but today are – and should be".

A major instrument in the implementation of these policies is the company's Customer Technology Application Center (CTAC in Irwindale, California. This is a demonstration facility that exhibits state-of-the-art energy-saving technology, developed by Southern California Edison *and* by other companies. The Center provides technical advice and assistance to companies that exhibit their technology at the Center. A recent schedule of coming events at the Center suggested an intensive demonstration and training effort to disseminate technology and know-how for energy-saving measures.

The demonstration and training dimension of CTAC's work can be illustrated by its exhibition of energy-saving technology for an activity as mundane as making *pizzas*. Southern California Edison has in place 55 energy-efficiency programmes to help customers save energy and protect the environment. One programme aims to improve air quality in both rural and urban areas by replacing internal combustion engines used in agriculture and manufacturing with cleaner electric motors. Another programme is developing variable air volume control systems that allow for individual temperature control of rooms in a building in an energy-efficient manner.

3. Designing environmentally sound production processes

E.I. Du Pont and Nemour, the large chemical company, has developed a ten-step environmental procedure which makes it possible to design production processes that minimize waste or reuse it entirely.[41] The procedure is also applicable in areas other than the chemical industry. It was recently applied in a major chemical factory and produced real environmental and economic benefits. It involved three major design modifications relating to feed (input) purification, recovery of raw material from the reactor purge gas, and modification of pump seals and valves to reduce fugitive emissions. All three modifications employed source reduction or reuse; none used waste treatment. The environmental benefits were a 99 per cent reduction in organic air emissions and a 22 per cent reduction in carbon dioxide. The economic rate of return was

[41] Robert L. Kraft: "Environmental review procedure for new facility design", in GEMI, op.cit. pp. 115-130.

45 per cent. This example suggests that enterprises can pursue environmentally sound policies while also reaping a handsome economic benefit. Box 5 describes the procedure.

4. Towards total quality environmental management

Environmental awareness has been rising in the corporate sector, particularly in the industrialized countries. There has also been increasing external pressure on enterprises, both from the public and from environmental groups, to put their house in order. Many firms have responded by switching from a piecemeal and defensive stance on environmental issues to a more proactive environmental policy, the aim being to make the company's products and production processes compatible with a safe, healthy and sustainable environment. *Total quality environmental management* are the new catchwords for enterprises aspiring to environmental excellence. Customers increasingly see environmental responsibility as a component of quality, and many firms realize that environmentally sustainable products and production processes may significantly improve their corporate image and competitive position in national and international markets.

Environmental excellence calls for company staff who are committed to the firm's environmental objectives, and motivated and trained to improve products, production processes and individual work performance. Many firms are now introducing comprehensive environmental literacy and specialist training for their staff in order to improve their environmental performance. Much of this training is what we could call mainstream training to improve quality and productivity and does not necessarily involve specialist training in environmental skills.

Total quality management demands a complete redesign of production and new staff skills, behaviour and attitudes – a new enterprise culture. The objective is to introduce the concept of quality at all stages of production, distribution and marketing. Quality is becoming the main argument in selling a product.

Total quality management requires that workers possess the motivation and skills to identify and diagnose defects in products and production processes and to undertake the necessary action to eliminate these defects. A sense of responsibility and communication skills are both essential tools in total quality

management. These attributes and skills are also fundamental in total quality environmental management. Total quality management offers the model for total quality environmental management because production design, management concepts and staff skills are similar.

Box 5

Procedure for designing an environmentally sound production process

The procedure consists of ten steps:

1. Initial screening of the factory site and the production process. The aim is to identify possible environmental issues and problems that need resolution. The next steps are only taken if a problem is found.
2. Appointing a staff member, not necessarily an environmental specialist, as environmental leader, who will identify and co-ordinate resources and ensure that the remaining steps are followed correctly.
3. Identifying the environmental objectives. These include a statement supporting government regulations and company policy, a list of objectives relating to the reduction of emissions and discharges, and possible other project objectives.
4. Finding out what permits (if any) the company needs in order to construct and operate the facility.
5. Identifying the compliance requirements stipulated in government regulations and company guidelines.
6. Carrying out a waste minimization analysis. There is no separate waste reduction technology. Instead, opportunities for waste reduction are imbedded in all aspects of production. To minimize waste effectively at meaningful levels, companies should have an accurate flow chart that identifies all major process streams and their composition.
7. Applying the best possible environmental practices. This involves reviewing the entire process to reduce unplanned releases, spills and fugitive emissions.
8. Applying the best waste treatment methods, once all the opportunities for waste elimination and reduction have been exhausted. The objective is to find the most cost-effective treatment to render emissions harmless.
9. Engineering evaluations for steps 6, 7 and 8.
10. A final review of the environmental impact of the project.

The following is an example of training in an enterprise committed to total quality environmental management. It covers both environmental management training and training to promote environmental literacy among the entire company staff.

Allied-Signal: Total quality environmental management[42]

Allied-Signal is a multibillion-dollar, global corporation with 210 facilities in the Americas, Europe and the Far East. It is engaged in the aerospace, automotive and engineered materials industries. Health, safety and environmental (HS&E) programmes are well established at Allied-Signal and designed to ensure rapid and full communication of information at all levels within the corporation. However, the company's HS&E professionals also face the challenge of keeping abreast of the latest regulatory requirements, maintaining compliance with existing external and internal requirements, and improving current processes and performance. Total quality environmental management (TQEM) offers the tools and the process to improve effectiveness, efficiency and environmental sustainability at Allied-Signal.

TQEM implies a continuous process of improvement that incorporates sound, common-sense technical and behavioural skills into existing HS&E processes. As figure 1 below illustrates, the role of management in the TQEM process changes as company staff move from innocence to excellence in relation to environmental awareness and skills. In different phases of the process, management directs, coaches and supports. The ultimate stage is reached when TQEM becomes totally integrated into every work process.

Figure 1. The TQM journey from innocence to excellence

[42] This section is based on Cathy Stevenson: "TQEM education and communications: The TQM journey that begins with education", in GEMI, op.cit. pp. 19-24.

Most TQM models used by organizations in various parts of the world combine existing TQM philosophies, tailoring them to their particular corporate circumstances and culture. However, all effective TQM models have certain tools and behavioural elements in common. These are a focus on the customer, both internal and external; process mapping (critically important to determine baseline evaluations of current processes and to identify specific areas that need improvement) and evaluation; problem-solving; corrective action; measurements; teamwork; communication and empowerment.

Companies with successful TQM processes generally recommend that the highest levels of management be trained first. Training lower level personnel before top managers may be ineffective because trained individuals may not be given the time, support and resources to apply what they have learned. It is important for a company to have a cadre of facilitators who can serve as instructors and coaches and provide technical assistance when needed. As awareness levels increase, facilitators are needed less and less. Support groups need to be established before training begins or developed simultaneously with training. These groups can give individuals the opportunity to bring issues to the attention of management. They can also provide resources and help; acknowledge the progress made by individuals and teams; ensure that a consistent and well-planned method is followed for each exercise, and communicate individual and team progress to others in the organization.

Allied-Signal has developed a Vision, Commitment and Value statement (table 4) which provides both an objective and a route by which employees are to achieve the objective. The TQM process helps employees translate this into action.

With major changes taking place in Allied-Signal's senior management and organizational structures, TQM training is considered an immediate priority. Starting with top management in January 1992, all company personnel will have received at least four days of basic TQM training by the end of 1993.

TQM training at Allied-Signal includes technical TQM tools and behavioural and communication skills. The tools are learned through applying them in solving problems. TQM training exploits everybody's expertise and knowledge in order to improve processes, make more effective decisions, and facilitate implementation. A "chain of command" management style is generally not compatible with high levels of employee empowerment. TQM advocates more decision-making by employees whenever appropriate and solicits inputs from them frequently. The philosophy is that those who know most about a problem or process should be most involved in its resolution or improvement.

Table 4: Allied-Signal's Vision, Commitment and Value Statement

Our Vision	We will be one of the world's premier companies, distinctive and successful in everything we do.
Our Commitment	We will become a Total Quality Company by continuously improving all our work processes to satisfy our internal and external customers.
Our Values	**Customers** – Our first priority is to satisfy customers. **Integrity** – We are committed to the highest level of ethical conduct wherever we operate. We obey all laws, produce safe products, protect the environment, practise equal employment and are socially responsible. **People** – We help our fellow employees improve their skills, encourage them to take risks, treat them fairly, and recognize their accomplishments, stimulating them to approach their jobs with passion and commitment. **Teamwork** – We build trust and worldwide teamwork with open, candid communications up and down and across our organization. We share technologies and best practices, and team with our suppliers and customers. **Speed** – We focus on speed for competitive advantage. We simplify processes and compress cycle times. **Innovations** – We accept change as the rule, not the exception, and drive it by encouraging creativity and striving for technical leadership. **Performance** – We encourage high expectations, set ambitious goals, and meet our financial and other commitments. We strive to be the best in the world.

Since adults learn best by doing, seeing and hearing, in that order, a participatory approach is followed at Allied-Signal. Team exercises not only enhance learning, they also promote communication with people.

5. Environmental training in small firms

None of these diverse environmental policies adopted by enterprises can be put into effect without a trained staff. Training becomes the key to improved environmental performance. Training costs can be compensated by improvements in quality, waste reduction and energy savings. The examples given so

far all describe the practices of large enterprises that can afford to spend money on training. Small firms, on the other hand, can only train staff by pooling their resources. Chambers of Commerce, municipalities and non-governmental organizations may also organize environmental training for these firms.

Belgium: Modular environmental training programme for small firms

In Belgium, the Strategic Planning Team for the Kempen has developed a modular environmental training programme for the regions small and medium-sized enterprises (SMEs). The training is given to SME staff who are responsible for environmental protection. It consists of six modules. The first five cover the global environment, pollution sources and effects, the measuring and analysing of pollutants, environmental law, and purification and recycling techniques. The sixth deals with the companys environmental investments, their economic aspects, environmental audits, external obligations and liability. This 35-hour training course is held in the evening. The programme is supported by the European Social Fund, the regions employment and training service, and its Administration for Environment, Nature and Rural Planning.[43]

B

Environmental training for government agencies

The environmental administrations of national, regional and local governments are also key actors in the environmental field. These environmental agencies propose and enforce environmental legislation, undertake environmental management, planning, research, and supervisory activities, and anticipate future environmental hazards. They are also responsible for the

[43] F. Geers, H. Bihler-Baudisch, G. Spronk: *Training and Environment*, Transnational CEDEFOP-Dossier, Annexe 1: Training Supply, October 1992, pp. 65-66.

management of renewable natural resources. The environmental managers employed in these agencies often have to make decisions on issues that have significant environmental ramifications. The quality of their work and the decisions they make depend to a significant degree on the training they have undergone.

Effective environmental protection demands that monitoring of environmental variables be carried out accurately and continuously. Managing the collection, analysis and interpretation of environmental data is the main task of environmental monitoring specialists. This provides the basis for decisions regarding policies and measures with environmental implications.

The following are examples of innovative training programmes that familiarize administrators and civil servants with the administrative, legal and technical elements of environmental policies and their enforcement. We also discuss in some detail the rationale for organising environmental monitoring activities and provide an example of training environmental monitoring personnel.

The Netherlands: Training for environmental policy-makers

The Noordhollandse Bestuursacademie, a further education institution in the Netherlands, has developed a 60 hour training programme for local government officials. The aim is to provide course participants with sufficient knowledge, insight and skills to assume an initiating and co-ordinating role in formulating and implementing environmental policy. The course does not require participants to have environmental expertise. The programme covers local governments' environmental policies, an integrated approach to hazard, noise and damage prevention, environmental policy planning, environmental education and information, environmental law and its enforcement, and the financing of environmental protection activities.[44]

The Netherlands Studie Centrum, another further education institution in the Netherlands, runs a three-day training programme for state, provincial and municipal government officials responsible for environmental law enforcement and for corporate lawyers and managers. [45]

[44] CEDEFOP, ibid., p. 173.

[45] Idem, p. 171.

Belgium: Training civil servants and police officers to enforce environmental law

The Universitaire Instelling Antwerpen in Belgium trains police officers and civil servants in supervisory positions to enforce environmental laws and regulations. The programme covers environmental law, the identifying, measuring and assessing of environmental offences, and law enforcement. [46]

Belgium: Higher studies in environmental management

The Institute d'Affaires Publique in Charleroi runs a training course intended for teachers and for administrative and technical personnel in municipal, communal, provincial and state administrations. The objective of the course is to help participants to identify environmental problems, to collect and manage relevant information, to mobilize the resources necessary to apply realistic solutions and to act as conciliators between conflicting opinions. [47]

Lombardy, Italy: Training voluntary ecological wardens[48]

Lombardy, in northern Italy, is a highly industrialized and urbanized region, two factors that have contributed to a deterioration in the quality of life and negative changes in the environment, such as air and water pollution, species becoming extinct, and soil degradation.

The region's environmental protection philosophy is to address the public directly. Decentralized environmental control and management stimulate the public to participate in environmental protection activities. The aim is not so much to repress harmful activities as to educate people and encourage environmentally sound behaviour. A Corps of Voluntary Ecological Wardens has been established and charged with monitoring the environment and enforcing environmental laws. The Corps is made up of citizens with "no previous criminal indictment". They are selected by a Commission after an intensive

[46] Idem, p. 79.

[47] Idem, p. 82.

[48] R. Gagliardi: *Training for environmental protection in the Lombardy and Umbria regions*, Training Discussion Paper No. 74 (Geneva, ILO, 1991).

training course covering environmental protection laws and basic knowledge about the regions environment. The Corps acts as an "environmental police force": it reports violations of environmental laws and has the power to impose fines for such violations. The voluntary ecological wardens participate in drawing up environmental maps. They also engage in activities to protect the environment in cases of ecological disaster. They monitor the territory continuously and keep the authorities informed about the environmental health of the region.

In Lombardy there are about 2,000 voluntary ecological wardens, organized into 59 teams. Since the scheme started, between 8,000 and 10,000 people have undergone warden training.

Through the ecological wardens, environmental protection is carried out by local people who are familiar with the area and local problems and can respond to the local population's sensitivities. The wardens participate effectively in campaigns for environmental education. They fill the communication gap between the authorities and the public and help to ensure that the latter becomes more concerned about environmental issues.

1. Anticipating environmental disasters: Organizing environmental monitoring and training

"Develop technical and institutional arrangements for affected countries to mitigate the effects of natural disasters through hazard-prevention measures, risk zoning, early warning systems, evacuation plans and emergency supplies" (*Agenda 21*, Chapter 13.15(c).

Preventive environmental policies demand an elaborate framework for monitoring and analysing environmental variables, exploiting this information in order to undertake preventive and, if necessary, corrective action, and formulating environmentally sustainable economic and social policies.

The prevention of environmental disasters and degradation demands an adequate knowledge base about environmental systems and their links with human activity. Models are needed that explain the links between human activities, environmental change and possible environmental disasters. These models are essential for the collection and analysis of environmental data and the drawing of conclusions from them.

Environmental monitoring activities should ideally be organized by experts in different disciplines (geology, engineering, ecology, information sciences, etc.). Their activities should be co-ordinated and there should be a decision-making system that comes into operation in urgent situations.

Risk scenarios provide patterns of possible risks to people and property. A risk scenario describes the possible development of an emergency situation and its possible impact on the environment. It is a tool for developing interpretive models. These models consist of a system of correlations between instrument measurements, which may represent forthcoming events, and risk situations which may result from the events. They also provide the information necessary to identify locations and areas under risk. Different interpretive models are developed for each risk situation and are then incorporated into the computer software of a given district's alerting units.

The instrument measurements undertaken and interpreted in real time make it possible to forecast future events and develop risk scenarios. When an emergency has been declared, the risk scenarios are employed to support decision-making.

The data provided by the monitoring network and interpreted according to the risk scenarios determine whether an area is safe or not. The alerting thresholds are established on an experimental basis by correlating the hydrological, geological and geotechnical events with the short-and long-term evolution of the environmental parameters. When the values of these parameters exceed certain pre-established thresholds, the situation is automatically identified by the computing system of the district alerting unit, which immediately warns the responsible engineer. The engineer verifies the detected anomaly and, if called for, informs the public authorities about the developing situation.

Remedial action is also an integral part of the safety management system. The monitoring network provides valuable information not only for the rational management of emergencies but also for planning environmental rehabilitation and reconstruction.

Detailed knowledge of site characteristics allows better understanding of the causes of risk, provides a guide for evaluating various options for action, and makes it easier to plan remedial measures. The monitoring network is also a safety guarantee for the personnel working in the construction area.

Box 6 gives a step by step enumeration of environmental monitoring and disaster prevention activities. The text that follows illustrates a training programme for technicians engaged in monitoring work in the Italian Alpine region of Valtellina.

Box 6

Activities for monitoring environmental variables and avoiding environmental disasters

Definition and upgrading of risk scenarios

- Identify risk areas.
- Propose risk scenarios and analyse their probability using existing data.
- Propose interpretative models for each risk situation, including the mathematical modelling of the behaviour of environmental variables.
- Elaborate new risk scenarios using the data obtained.

Data acquisition

- Decide what are the pertinent environmental variables to collect.
- Organize the collecting system, deciding where the environmental variables will be collected, and how frequently, and how accurate they need to be.
- Choose the measuring instruments.
- Organize the maintenance of instruments (this can be a very difficult task in some environmental conditions, such as mountain regions).

Data validation

- Set up a validation system for each instrument in order to ensure the accuracy of the data (this can be difficult when the instruments are located in regions that are not easily accessible).

Data processing

- Set up analytical systems, deciding what computer programmes will be used, how data will be input into the computer, and how data will be analysed.

Database management

- Organize the database and interaction between new and old data.

Issuing of warnings

- Define warning procedures.
- Establish an "alarm system" that distributes the necessary information about possible environmental disasters to the relevant people (authorities, etc.).
- Organize decision-making systems.

Improving the environmental situation

- Propose changes in human activities that are necessary in order to improve the environmental situation (environmental degredation, quality of life degredation, etc.).
- Negotiate with the social sectors affected by the changes.

Personnel training

- Organize the training for necessary staff. It is advisable to train local people to maintain and operate the system, and to avoid conflicts between local inhabitants and external organizations operating in the region. The participation of local people in these activities can help to solve unemployment problems.

Valtellina, Italy: Training for environmental monitoring

A major environmental disaster on the scale of the Valtellina landslide in 1987 was needed to provide the momentum for developing a full-scale monitoring programme in the region, and in its wake, purposeful environmental training.

Monitoring the stability of the mountain slopes is vital to the safety and well-being of the people, farms, villages and towns of the valley. It is also a crucial element in safeguarding the environmental health and sustainability of downstream river basins (in this case the Po river basin, which stretches from Alpine meadows close to the Swiss border in the north, through major cities such as Milan, Verona and Venice, to the Adriatic).

After the landslide in 1987, the Ministry of Civil Protection assigned to ISMES, an environmental engineering company, the task of improving the safety and livelihood of the Valtellina population. ISMES is a recognized national authority on the monitoring of mountain environments. It owns and equips the three regional monitoring centres (in Sondrio and the nearby villages of Cepina and Mossini), but has subcontracted the management, maintenance and operation of the centres to CO.RI.VAL, a local co-operative. Most of the staff that run the centres are graduates of the CO.RI.VAL training programme, but ISMES does provide some scientific experts. At the Mossini monitoring centre, for example, three scientific staff members (two geologists and one manager) are supplied by ISMES out of 15 staff members in all. The local authorities in the Valtellina area then undertake any remedial work or infrastructure development suggested by analysis of the data collected by ISMES and CO.RI.VAL.

To determine the need for environmental construction and remedial work, *specialized* maps are drawn. These illustrate in minute detail slope gradients, soil quality and stability, rainfall and other variables. This information allows ISMES and CO.RI.VAL to work out *risk scenarios* based on the variables and their changes as documented in the data bank. Information for these maps is provided in part by the monitoring devices located throughout the mountainous region and in part by external information centres. ISMES also undertakes modelling activities and develops its own software to this end. For example, hydrological models determine the correlation between rainfall and surface movements.

Box 7

Valtellina: Monitoring and safety management

In Valtellina a network of instruments (sensors, data acquisition units) keeps under continuous surveillance all the hydrological and climatic aspects of the region (land slope instability, surface and subsoil hydrology, etc.). Around 100 measuring sensors are located at possible risk-developing sites and are connected to the remote data acquisition system, located at Cepina (for the hydrogeological monitoring of Val Pola and Presure) and at Mossini (for the hydrogeological monitoring of Val Torregio and Franscia, and for the hydrometeorological monitoring of Val Malenco and Alta Valtellina).

This automatic data collection makes it possible to process and evaluate the data in real time, and guarantees both a high degree of accuracy and timelines for activating predetermined emergency procedures.

All data are processed using a safety check programme which, through alerting video monitors, permits continuous control of site conditions. The computer at the Regional Unit of Cepina is connected – via radio and surface line – to the computer at Mossini. This is in turn connected to the Remote Technical Support Unit at ISMES headquarters in Bergamo.

Training mountain territory technicians

In 1986 the CO.RI.VAL co-operative organized the first training programme for mountain territory technicians in order to develop the skills needed for monitoring and prevention activities in Valtellina. A second course was offered in 1990. Twenty students participated in this latter course, out of which ten went on to join CO.RI.VAL. Eighty per cent of the students who completed the courses found work in the region without difficulty. The creation of employment opportunities was one of the first objectives in creating the co-operative. Students on the courses were required to have high school diplomas, but some had university qualifications. The trainers were mostly ISMES staff and other professionals from the region.

The CO.RI.VAL database system receives data at the rate of 400 data per half hour from approximately 100 data collection units distributed around the Valtellina area. Managing this continuous flow of environmental data demands highly developed computer skills in data collection, processing and management. Development of information technology skills is therefore an important aspect of the course, taking up nearly half of the course time. Students are also required to develop an in-depth knowledge of the geography and economy of the area.

After finishing the basic mountain territory technician course, some students went on to receive specialized training in the use of the database software. This training was provided in the form of a short "internal" course. Because the information that is entered into the database must be carefully screened for accuracy, students must learn to develop and use specific forms, which require very specific input data. Students are trained to use both larger network computers and smaller independent personal computers, in order to meet the needs of all clients.

Exhaustive training cannot be accomplished in a short training period, since understanding complex concepts requires prolonged exposure to both the theoretical and the practical aspects of monitoring work. Practical learning on the job therefore complements the training course.

Trainees at the Mossini monitoring centre must be able to analyse data critically rather than accepting it indiscriminately. CO.RI.VAL's technician training is therefore evaluated and reinforced by means of a two-way feedback system at the monitoring centre. After analysing the data, the technicians produce daily environmental reports which are reviewed by the geologists at the centre and also sent to ISMES's main office in Bergamo for review and assessment. This feedback system acts as a mechanism for learning on the job, which is necessary for putting into practice the theory taught at the training course.

The CO.RI.VAL training programme has the backing of several large companies which provide equipment, financial support, and often employment for CO.RI.VAL's trainees. These are the beginnings of close collaboration between private enterprises and public institutions in effective management of the local environment. Since the environmental disaster which fuelled support for the programme, CO.RI.VAL's administrators have progressed rapidly in their aim at providing qualified monitoring services for the region.

C

Training farmers for sustainable agriculture

"Governments... should provide support services and training recognising the variation in agricultural circumstances and practises by location; the optimal use of on-farm inputs and the minimal use of external inputs; optimal use of natural resources..." (*Agenda 21*, Chapter 14.18(f).

Agricultural practices have a significant, and often negative, impact on the environment, as described in Box 8. Farmers and other people engaged in agriculture are therefore another important target group for environmental training.

Box 8

Environmental change and agriculture

In earlier times, hunting, fishing and gathering ensured, for a limited number of people, a sufficient supply of food and the requisite materials for clothing, housing and other basic necessities of life. Later, agriculture made it possible to feed larger numbers. However, agriculture generates environmental change through the cultivation of one or several species at the expense of many others. Clearing land for agriculture means that a few species replace a virgin flora and fauna of hundreds of species. Other agents of change, essential for maintaining the productivity of land, include irrigation, the use of fertilizer and pesticides, and changes in soil structure and topography. A continuous effort is thus necessary if agricultural production is to be maintained. If this continuous effort exceeds certain levels it can trigger a cascade of environmental processes that degrade both local and distant environments. An example is the eutrophication of lakes, rivers and coastal waters.

Farmers who use intensive agricultural practices are major polluters of soil and water. Such pollution is a danger to health and can generate irreversible environmental change. In most industrialised countries, industrial and agricultural pollution and urban waste make rivers highly polluted. In France, for example, the major rivers have a high concentration of nitrates, mainly resulting from the run-off of animal manure and chemical fertilizers from farms.

Existing agricultural practices need to change in order to reverse environmental degradation in the countryside. This requires fundamental agricultural reforms. Farmers need to reduce the use of fertilizer and pesticides. Farmers' production objectives need to change, with the emphasis moving away from maximizing output towards optimizing income and ensuring sustainability. Farmers can raise their incomes by diversifying their output and by introducing new, complementary activities that add value to their produce. Such activities may include rural tourism, food processing or small-scale industrial activity. The need for fertilizer can be reduced by rotating crops, while use of pesticides can be reduced by reliance on the natural enemies of pests.

Changing farmers agricultural practices requires new attitudes. Farmers must be motivated to assume responsibility towards the environment through a change in attitudes supported by an understanding of basic environmental concepts. Helping farmers understand that their activities may have a negative impact on local and distant environments will contribute to changing their practices. Training can help them avoid an often occurring vicious circle: using large quantities of insecticide kills the natural enemies of pests while making the pests themselves resistant, which in turn leads to using even larger quantities of insecticide. Reducing the use of insectisides reduces their presence in food and lowers the risks to human health.

The following examples from France and Indonesia illustrate attempts to provide environmental training for farmers, the aim being to reduce the negative impact agriculture has on the environment and at the same time to raise farmers incomes and well-being.

France: Training for farmers in the Marenne-Oleron marshlands

Marshlands are ecologically important because they reduce fluctuations in salinity on the coast and so ensure a more stable environment for sea species. With good management, marshlands can accommodate different production systems: cropping of corn, oil seeds, colza, etc., alongside extensive use of natural grasslands for livestock.

As agriculture in the Marenne-Oleron region is intensive, the environment of the marshlands has changed and oyster production – an important economic activity – has declined. Farmers tend to maximize output using intensive agricultural practices. However, economists and farmers in the region stress the viability of an extensive agriculture that respects the environment while giving farmers a net profit comparable to that from *intensive* agriculture. In Marenne-Oleron, a number of training programmes have been organized that encourage *extensive* agricultural practices.

One such programme integrates environmental protection considerations into agricultural training. The aim is to promote multiple cropping and animal breeding among farmers, complemented by rural tourism, product development and aqua farming. The course[49] helps farmers analyse their agricultural business and develop their activities while respecting the fragile marshland environment. They are introduced to cost-benefit analysis as a tool for decision-making.

Indonesia: Encouraging the natural enemies of pests

Rice is the worlds most important food, but pests can severely damage rice crops. In Indonesia, for example, the brown planthopper had by 1986 reached plague proportions, devouring a quantity of rice that could have fed 3 million people. Neither breeding resistant strains nor using tons of pesticides seemed to prevent the bug from spreading. In fact research revealed that pesticides had actually made things worse by encouraging the development of resistant strains of the pest.[50] An environmentally sound solution is to promote the growth of the pest's natural enemies, to monitor the quantity of pest insects and their enemies, and to apply pesticide only when necessary.

In Asia, an innovative and highly succesful programme[51] is underway to train rice farmers in integrated pest management techniques. In Indonesia, where the programme started, farmers have learned to produce healthy rice

[49] "B.P.A. Chef d'exploitation ou ouvrier hautement qualifié en polyculture élevage", at the Centre de formation professionnelle et de promotion agricoles in Bourcefranc, France.

[50] Richard Stone: "Researchers score victory over pesticides – and pests – Asia", in *Science*, May 1992, Vol 256, No. 5061, p. 1272.

[51] Inter-country programme for integrated pest control in rice-growing in South and South-East Asia, a FAO programme financed by Australia, The Netherlands and the Arab Gulf Fund.

crops by conserving the natural enemies of pest insects, mostly wasps and spiders, and monitoring their fields weekly. The programme makes them experts in their own fields. The benefits are increased output, savings on pesticides, and improved incomes. Further benefits are environmental sustainability, reduced levels of pesticides in farm produce, and improved health among farmers and consumers of farm produce.

The programme trains farmers to monitor the spread of pests and their natural enemies, using simple observation techniques. This enables farmers to take appropriate decisions about the use of pesticides. Training in pest management is integrated with training in farm practices to improve yield and health of crops.

Farm practices adopted by farmers have to be uniform in order to be effective. Excessive use of pesticide by one farmer will undermine the efficacy of pest management practices by other farmers. A common understanding about the best practices is essential. A community training approach is therefore used to reach this understanding. Eighty per-cent of training time is devoted to on-the-job training. Visual demonstration techniques are used in the field. So far, some 400,000 farmers have been reached by the programme in Indonesia. Because of the large number of participants unit costs are very low: US$ 3.43 per day for full-time residential trainers' training and US$ 0.73 per day for farmers' training.

The programme is revitalizing the existing network of village farmer groups by organizing and running IPM (Integrated Pest Management) Farmers' Field Schools – *schools without walls* – where 25 farmers meet for five hours once a week during the 10-12 week long crop season, from transplanting to harvest. Each field school has a 1,000 square metre *learning field* – a farmer-run rice field where IPM techniques are used, and where "farmers and future trainers observe plants and insects, then come to a consensus on how best to manage the rice based on their observations, experiences, and weather forecasts. Instead of relying on pesticides as a magic bullet to cure ailing crops, the farmers learn, among other things, how to add the right amount of fertilizers and how to manage water supplies. In addition, the farmers are trained as amateur economists – they learn how to forecast the amount of pest-induced damage that is tolerable before opting for pesticides. IPM strategy for rice boils down to a simple axiom: Pesticides usually do more harm than good because they kill beneficial insects."[52]

[52] Stone, op.cit., p. 1272.

Trainers produce their own training materials by using collections of insects, field trial plots, posters and workbooks. They create and use tools for analysing the agro-ecosystem. They solve problems and make decisions. IPM trainers learn to manage their own programmes and farmers learn to set-up and run complex learning activities."[53]

The IPM programme has been highly successful in improving crop quality and quantity and reducing the incidence of the brown planthopper.

D

Environmental training for trade unions

"Trade unions should continue to define, develop and promote policies on all aspects of sustainable development". (*Agenda 21*, Chapter 29.9).

Workers and their trade unions can be considered to be "environmental" organizations by virtue of the high priority they give to the working environment. And they now recognize that the working environment is closely interlinked with the external environment.

Workers' increasing environmental awareness is not only a matter of changing perceptions but also related to their traditional concern about living conditions, such as housing, transport, availability of food, water and sanitation, education, leisure and recreation. Environmental activism has been reinforced by the realization that warnings about plant closures and economic disruption being triggered by environmental policies and regulations have been greatly exaggerated. Many trade unions and workers now realize that, far from destroying jobs, properly formulated and implemented environmental programmes offer good employment opportunities. Workers also understand that jobs in environmentally unsound economic activities are not sustainable in the long run. Hence the need to establish environmentally sound employment.

[53] Indonesian National IPM Programme: "*Farmers as experts*".

In cases where jobs are lost or threatened by environmental action, workers insist that the burden of adjustment be equitably shared between the worker and society. Society will in any case benefit from an improved environment. Training, retraining and relocation and other support and adjustment measures should be available to help those who lose their jobs. For these reasons, workers and their organizations are becoming increasingly involved in general environmental issues at the enterprise level and also in regional, international and sector-based organizations. What, then, can they do to promote good environmental practices?

Here is a short (and by no means complete) list of activities and potential roles for workers and trade unions at the enterprise level:

- In their day-to-day work, workers can help in improving their working conditions and the general environment. They should ensure that they are informed and consulted at an early stage on all environmental questions.
- Workers should be actively involved in designing and implementing environmental policies, and where this might lead to a loss of employment should participate in establishing a "safety net", for example by identifying new employment opportunities.
- Workers should participate in the design and development of training programmes for workers and management to raise environmental awareness and promote the skills necessary to meet environmental objectives. Particular efforts should be made to ensure that workers' health and safety representatives or special environmental representatives receive appropriate environmental training.
- Workers should urge employers to recognize good environmental performance by workers and management and provide incentives for such performance.
- Workers should collaborate with employers, governments and consumers to ensure that the "polluter pays principle" is enforced and that the costs involved are not simply passed on to the consumer without the polluter making the necessary environmental investments.

Many of these activities are also relevant for trade union organizations at the national, regional and international levels, which will need to strengthen their capacity to provide support, including information, training and advice, to workers and their organizations at the enterprise level.

Environmental training is an important tool to raise trade unionists awareness about the environment and to empower them to address environmental issues vital to the jobs and livelihood of their members. The objective of such training is to provide trade unionists with the environmental skills and knowledge they need if they are to influence decision-making at the national, local and enterprise levels. Training will also enable trade unions to organize activities that improve the quality of life and work of their members, reverse environmental degradation, and stimulate the creation of environmentally sound jobs.

1. The territorial approach

In order to reach these objectives, trade unions must use territory or area as the main unit of analysis, rather than focus on the enterprise. A good example of environmental training that uses the territorial approach is provided by the seminar courses organized by the GAIA (Centre for Research and Environmental Initiative) in the region of Emilio Romagna, Italy. The GAIA is financed by the CGIL (Confederazione Generale Italiana del Lavoro), one of the major trade union federations in Italy. The GAIA provides trade unions with documentation, research and training services on environmental issues.

Italy: The GAIA programme

In a sense, the GAIA programme was a timely trade union response to a recent change in Italian environmental legislation. Up until 1990, environmental standards were fixed for each enterprise. A chemicals firm, for example, was allowed to emit a certain amount of various polluting gases and liquids into the air, soil and water streams, depending on its location and the type of chemicals it emitted. The major shortcoming of the legislation was that it ignored the cumulative and reinforcing effects of various pollutants. Often the combined effect of several pollutants is greater than the effect they exert on the environment separately.

The Italian government has therefore given responsibility for implementing and enforcing environmental legislation to the Hydrographical River Basin Authorities (Autorita di Bacino Idrografica). The authority for each river basin area and its surrounding region must develop a comprehensive programme

setting out environmental standards and protection measures addressed to all the industries in the area under its authority. The reason for choosing the river basin authorities was that pollutants tend to accumulate in the water environment, where their effects can be measured by monitoring aquatic life and the water itself.

The principal parameter for environmental protection is the *environmental carrying capacity* of the local and surrounding river basin area. It is against this parameter that environmental pollution and prevention activities will be measured in the future. River basins therefore provide a good overall picture of the environmental health of a particular region.

For this reason, the courses organized by the GAIA are centred around the concept of territory, in particular that of the Reno river basin, the analysis of which makes it easier for the participants to understand how environmental variables influence each other. Seminars cover themes such as the links between environmental and social problems, and the relationships between patterns of production, consumption and environmental degradation. Environmental legislation and environmental policies are also discussed.

The training methodology

The organizers of the GAIA course consider it vital that training should stimulate students to build new environmental knowledge and improve their analytical and problem-solving skills. The aim is to stimulate discussion about the cultural, economic and technological changes in the Reno basin that are needed if damage to the environment is to be lessened.

The course uses an inductive approach. The participants discuss a given problem and reach conclusions that form the basis for the intervention of experts. Later in the course, information about the Reno basin and its major environmental problems is introduced. This information is used by the participants to help them identify specific environmental problems that call for action and formulate solutions to them. The proposals would then provide a basis for trade union initiatives on the environment in the basin.

This approach ensures effective learning as the training is based on participants' views about the environment. The seminar leaders also learn from the programme by analysing the experience of the participants.

E

Training environmental trainers

"...specialised "training of trainers" programmes should be established to support training at the national and enterprise levels..." (*Agenda 21*, Chapter 36.16)

For effective environmental training, the major instrument of training – the trainer – must have the necessary knowledge, skills and experiential background to introduce students to environmental concepts and problem-solving techniques. The environmental trainer has to combine teaching skills with an in-depth knowledge and understanding of environmental systems. The trainer must be able to identify trainees' learning difficulties and devise training strategies and methods that will help them overcome these difficulties. Another important task of trainers is to promote the development of an environmental ethic among their trainees.

Vocational teachers are often highly specialized and unfamiliar with multidisciplinary methods, which are essential for finding solutions to environmental problems. Communication between the various disciplines is poor, and creating interdisciplinary training programmes to solve environmental problems is fraught with difficulties. Effective training programmes for trainers must therefore emphasize as a learning objective the development of the multidisciplinary skills needed to tackle environmental issues. These would encompass both occupation-specific skills and knowledge and an understanding of environmental issues in their economic, political and cultural contexts. In addition to being competent in their special fields, trainers must have a basic understanding of both the human and the "hard" sciences. Training should convey the environmental concepts and tools required for integrating environmental issues into their teaching programmes. Teachers should also be motivated to encourage concrete environmental action among students in their day-to-day consumption and work.

Using examples from Germany and Italy, some issues relating to training environmental trainers are discussed below. The German examples illustrate the difficulties of developing an adequate training programme for environmen-

tal trainers. These difficulties are inherent in any large and complex education and training system. The other examples, from Italy, examine some means of overcoming the difficulties of changing trainers' training methods.

1. Training vocational school teachers in Germany

Although the (then West) German Minister of Education had made an appeal for further environmental training for teachers as early as 1981, little progress was made in this area in the 1980s. No specific projects were developed, nor were any teaching materials produced. The Government's new educational policy of 1990 stated that "further training for teachers should cover primarily questions of internal school reform, e.g., problems of co-education, environmental training, the status of teachers in vocational schools. The undue pre-eminence of courses in new technology is to be reduced." The 1992 programme stated that "Further opportunities in environmental training have been significantly increased. These serious problems require a restructuring of both school and teaching content. This government is particularly concerned to support teachers in this task".[54]

Due to a change in policy, the number of courses on offer has increased since 1992 and the emphasis has been on integrating environmental training into technically oriented further training programmes. Also in 1992, for the first time, courses were offered that linked job-related environmental and new technology training. However, there are still far fewer of these courses than are needed, and few teachers will have the opportunity to attend them. Unlike the situation with new technology training, vocational school teachers have as yet little access to environmental training and qualifications. Recognized environmental teacher qualifications are also lacking at present.

Teachers at vocational schools are therefore obliged to develop their environmental skills largely on their own. It is only owing to the commitment of a few individuals that job-related environmental training is carried out at all. One such group of individuals is the Working Group on Environmental Training at the University of Hanover Institute for Vocational Teacher Training. The

[54] Institut für Umweltschutz und Berufsbildung e.V.: *Environmental training and further training in Germany*, Training Discussion Paper No. 112 (Geneva, ILO, 1993).

Group has conducted some ten courses as part of the state-run Teachers' Further Education Training Programme.

Hanover, Germany: Learning to manage a renewable energy system

One of the courses run by the Hanover Working Group was on managing a renewable energy supply system, using wind-power plants on the coast as cases for study. The course was attended by 24 people, mostly metal and electrical engineering teachers from vocational schools. The topic was chosen because "the development of renewable forms of energy supply" was considered a learning objective. Boosted by new promotional programmes, this type of energy production is at present enjoying a boom in Germany.

The one-week training course familiarized the teachers with various aspects of managing and operating wind-power plants. Experts provided exhaustive technical information on the topic of wind energy, which supplemented the information distributed to the participants prior to the course. The course organizers encouraged participants to contact various users and producers of wind energy for information and know-how about the technology. Participant teams then visited some of these contacts, evaluated their findings, prepared scenarios, a video and teaching materials. The participants produced a graphic representation of the system of renewable energy production and consumption. At the end they were encouraged to draw lessons from their visits for their own teaching work and to evaluate whether the course promoted associative thinking and action learning.

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a. Some issues relating to the training of environmental trainers in Germany

Some pilot projects in Germany have suggested that the best results are achieved by integrating the general and job-specific aspects of environmental studies into trainers occupational training and further training programmes. Project-oriented working groups, in contrast to traditional seminars, are a useful mode for teacher training, because of their close affinity with concrete environmental issues and solutions. Many teachers in Germany have stressed that training must be supported by suitable teaching and learning aids, which calls for a considerable development effort. Since in Germany teachers' certification is central in creating a competent cadre of teachers, intermediate and final

teacher examinations also need to integrate environmental issues and questions and qualified examiners need to be trained in this new area.

Teachers' training programmes should familiarize teachers with the environmental issues confronting local government bodies, local institutions and local enterprises. Enterprises can help teachers develop purposeful, concrete environmental training projects. At present, German vocational schools are discussing the idea of sponsorship by enterprises and other institutions and co-operation projects between schools at home and abroad. This is expected to encourage the creation of networks for environmental project work in schools.

b. Decentralizing training

In Germany, local and regional provision of training for environmental trainers is gradually replacing courses run by the central education authorities. Regional governments and independent bodies are slowly developing their advisory capability, for example by appointing environmental consultants for vocational schools. Local and regional training projects are often initiated by committed teachers in response to locally expressed needs and dissatisfactions. In East Friesland, for example, the (Hanover) Working Group on Environmental Studies in Vocational Training, jointly with 15 vocational schools and other institutions in the region, has developed a project to integrate environmental studies into schools' programmes. The project is subsidized by the Cultural and Educational Centre of the Ostfriesische Landschaft, an independent non-profit organization. Further teacher training is increasingly organized by private institutions, teachers' organizations, trade unions and environmental education associations.

2. Training school teachers in Italy

As observed earlier, environmental education and training should ideally be centred on the learner. This calls for a new training methodology and a change in teachers' attitudes to training. Another essential requirement is that teachers should possess sound scientific knowledge and the ability to take a multidisciplinary approach in their teaching. Developing the requisite attitudes, knowledge and skills is a fundamental task of teacher training. The examples that follow illustrate how this can be done.

Lombardy, Italy: Two-year courses for teachers

In 1985 the Regional Institute for Teacher Training (IRRSAE) in Lombardy began to organize environmental education courses for secondary school and high school teachers. The two-year courses used the *research action* methodology. Teachers concurrently taught and undertook research on teaching methods. Teams of secondary school teachers analysed the characteristics of their students, their ideas, knowledge, beliefs, logical capacity and ability to understand complex systems. They also examined the basics of various social and natural sciences and identified the best teaching strategies. At the end of the course they proposed programmes and methods for environmental education that were adapted to particular school situations and particular characteristics of students. The course also encouraged teachers to work together on joint projects in their daily teaching activity.

Pavia, Italy: One-week courses for teachers

Another example is a week-long training seminar for teachers organized by the University of Pavia in the National Park of Ticino. The teachers learn how they can use the resources of the park -natural sites, monuments, churches, cultivated fields, forests, rivers etc. – for environmental education. They attend lectures about the park environment, its geography, history and economy, and about the methodology of teaching. Teams of teachers analyse the parks resources and design training programmes that they are later expected to use in their teaching. For example, one team proposed a short education programme centred around the use of the park in the Middle Ages. This programme, which also includes visits to the park by students, examines how the population developed new techniques of production, and the impact these had on environment, economy, culture and religion of the time.

F

Women and the environment

Women are major contributors to development and the livelihood of their families, communities and countries. They use environmental resources as they

collect fuel, food and fodder and carry water. They are the biggest group of consumers and major producers of goods and services. Women farmers work to produce basic food and crops for export, so their role is crucial to the sustainable use of land. Women workers in industry and other formal and informal activities are often engaged in production which has an impact on the environment. A great challenge for environmental training is to mobilize women to take charge of their environment, empowering them to meet their needs and those of their families in a sustainable manner. The example that follows provides an example of women's empowerment through environmental training.

Kenya: A programme of afforestation

In Kenya, excessive wood-cutting has resulted in deforestation and is forcing women to spend several hours a day collecting wood further and further away from their homes. A programme of afforestation has been put into place in order to reduce the need for women to undertake this arduous and time-consuming work.[55] The programme has also generated new economic activities, such as growing fruit and extracting wood from the forest in a sustainable manner. Other benefits have been greater biodiversity and improved working and living conditions, as the forest gives shade and reduces temperature.

The programme is run by the country's Ministry for Environment and Natural Resources and is assisted by other governmental and non-governmental organizations. Some 50 women's groups support the programme, investing in plant nurseries and planting trees in different parts of the country. Through training, women learn to integrate modern management techniques and technology in their forestry and agricultural activities. This helps them to participate better in the community economy and also promotes their cohesion as a group. The plant nurseries also show other members of the community, including children, that they can grow their own trees.

The programme has met certain cultural resistance. In some regions planting trees is considered an essentially male activity and taboos prevent women from engaging in it. Beliefs that the tree will die, that the woman will become sterile, or that her husband will die if she plants a tree are examples of such taboos. They favour the traditional view that men alone can own land. If

[55] Elizabeth Obel, "Women and afforestation in Kenya", in *Voices from Africa* (UN Non-Governmental Liaison Service (NGLS), 1989), pp. 15-26.

women own trees, they might then claim the right to land. Some women have overcome these taboos, using young men to do the actual planting of trees while they undertake all the other forestry tasks.

G

Informal sector workers and the environment

A conspicuous phenomenon in many developing countries is the mushrooming growth of the informal sector. As formal industrial and service sectors stagnate and even decline, and rural populations migrate to the cities, the majority of people are forced to eke out a living in informal sector activities. This means working as street vendors, engaging in low-technology industrial production, recycling industrial and urban waste, or engaging in any other activity that gives some means for sustaining a livelihood, however meagre. Living and working conditions are poor and people often lack access to basic services such as health care, education, water and decent housing.

These poor living and working conditions often have a negative impact on the environment owing to obsolescent modes of production and lack of waste disposal systems and sanitation. Bad environmental conditions in turn generate poverty as they exacerbate poor health and poor sanitary and working conditions. Poverty, lack of education and poor environmental conditions thus form a vicious circle.

The vicious circle can become a *virtuous* circle if people are trained to use environmental resources better and so raise their incomes, improve their sanitary and general environmental conditions and enhance their quality of life. Expanded economic activity and job creation are major benefits. Environmental improvement in the informal sector offers much scope for training activity, for example training in the use of alternative energy sources, recycling urban and industrial waste, urban agriculture, housing construction and preventive health care.

The examples that follow represent innovative attempts to improve environmental conditions and create jobs.

Bangalore, India: Training for solid waste recycling

The Waste Wise project in Bangalore shows how a comprehensive view of local solid waste problems can evolve from grassroots social action for waste-pickers.[56]

The project, launched by the Mythri Trust and other NGOs and funded for one year by Terre des Hommes, Switzerland, explores alternatives to the conventional solid waste system and is based on waste reduction and the separation of compostable, recyclable and other wastes. It is a decentralized programme, combining specific social, economic, environmental and educational objectives. Its aims are to bestow legitimacy on the informal waste work of the pickers, to improve their earnings, and to create opportunities for upward social mobility whereby waste-pickers can enter into waste processing, trading and recycling. It also aims to change attitudes towards waste so that its importance as a resource is recognized. The project analyses and disseminates information about current solid waste management methods, brings together community and environmental groups for education and project work, and identifies low-cost technologies that can improve waste processing and handling. In soliciting the support of the city authorities, the project shows how the latter can reduce waste and decentralize waste treatment and so create jobs and save on collection and transportation costs.

In a pilot project in a residential area in Bangalore, Waste Wise works closely with local waste-pickers. It has prepared slide shows and videos to explain to residents and special interest groups in the area the benefits of separating recyclable products and materials and of local composting and recycling. Former waste-pickers, equipped with handcarts and baskets, now pick up the separated wastes daily from the 300 project households, which pay a small monthly fee for the service. They take the organic materials to the compost site, sell the dry recyclables and dispose of residues in communal bins. The collectors are trained by a supervisor, paid by the project. They are mostly children aged 10-15; they receive 300 Rs. per month from the fees collected and free tea and food. In addition they earn about 15 Rs. a day from selling recyclables to local waste shops. This work is not financially attractive to adults, who can make more money from independent street-picking throughout the day.

[56] Christine Furedy: "Garbage: Exploring non-conventional options in Asian cities", in *Environment and Urbanisation*, Octo. 1992, Vol. 4, No. 2, pp. 44-46.

The residents are generally supportive of the concept of waste separation, but the work is left to servants who may resent the extra work required. Some households are reluctant to pay, others find the schedule inconvenient and resort to using the communal bins. Some residents are suspicious of the collectors, as they are mostly pavement dwellers.

The Waste Wise group hopes to transform approaches to solid waste management in Bangalore by building on social *and* environmental motivations. Young street-pickers gain cleaner, more productive and more respectable work. The group argues that separating wastes to enhance their value for recycling can become part of an environmental ethic in the city. This ethic can be strengthened if the neighbourhood environment improves through the elimination of overflowing communal bins. Its continuance will depend on gaining more resources and staff to expand participation.

Curitiba, Brazil: Environmental education and training for children

The Infant and Adolescent Environmental Educational Programme (PIA), in Curitiba, Brasil is addressed to children and adolescents in the city's slums, *favelas*, and other low-income areas. Participants in the programme learn vegetable farming, gardening and other job skills. The money they earn as farmers and gardeners they give to the *favela* neighbourhood association. As a result of the programme, children feel more part of the community and the surrounding environment is protected and improved instead of being destroyed. Family life has improved and the programme has the full support of the community. At the end of 1992 the programme was expected to operate some 28 units with 250 children each. It has been nominated a United Nations Local Government Honours Programme by the International Council for Local Environmental Initiatives for *environmental regeneration of low-income communities*.[57]

[57] Jonas Rabinovitch: "Curitiba: Towards sustainable urban development", ibid., pp. 62-73.

Conclusions

At the end of this millennium environmental policies are becoming an integral part of economic and social policies. The ultimate goal is a development model that is sustainable in the long run. Only preventive policies can eliminate the causes of environmental degradation and disasters. Putting into effect such policies will demand fundamental changes in the objectives, modes of operation and organization of industrial society. In the developing world, sustainability can only be achieved by introducing environmentally sound production practices in agriculture, fishing and forestry, controlling population growth, and managing urbanization. Sustainability also requires changes in individual behaviour, particularly consumption behaviour.

Only a transition to a pattern of sustainable development can avoid further environmental degradation and ensure the human race a healthy, stable environment and a better quality of life for present and future generations.

All individuals have an impact on the environment in their economic, social and cultural activities. Environmental awareness is an essential element in reducing this impact but it is not sufficient. The requisite behavioural change can only come with a new ethic. Education and training are major tools in creating and diffusing this new ethic. It should be person-centred, promoting environmental literacy, collective action, local and international solidarity, and popular participation.

Education and training are fundamental to instilling the knowledge and skills necessary for putting into effect measures that are compatible with sustainable development. Environmental training can also have other beneficial effects. It promotes better health and sanitary conditions and can be a stimulus for job creation and income generation, particularly in low-income urban areas.

Professionally trained people are needed to identify environmental problems and implement the necessary measures. Popular support and participation by an educated public will also be needed. In order to make economic activity environmentally sound, all employment related training should ideally integrate elements of environmental protection. Three major types of environmental training are therefore singled out: environmental literacy training for the general public; job-related environmental literacy training and environmental training for people engaged in environmental protection jobs.

At present environmental protection jobs constitute a fairly stable 1-2 per cent of the labour market in industrialized countries. Most of these involve undertaking corrective environmental protection measures. Putting into effect preventive protection measures on a large scale calls for a major effort to integrate environmental knowledge and skills in existing professions and to design new occupational profiles for environmental jobs.

The environmental job market is diffuse and fragmented. Changes in demand generated by environmental policies are difficult to anticipate. Excessive specialization in certain skills and protection areas can reduce the capacity of training institutions and individuals to meet unforeseen labour market demands. Training programmes should instead promote the individual's ability to adjust to changing labour market conditions and occupational requirements. A good basic education and environmental understanding are the foundations for this ability. Environmental literacy training for the general public is the best means for developing environmental understanding. Environmental literacy demands a basic knowledge of the natural and social sciences and the ability to understand complex systems.

Accordingly, environmental training should be multidisciplinary, focusing on the complex interactions between environmental phenomena and human activity. Training should also stimulate the adoption of an environmental ethic and develop the capacity to manage situations of conflict on environmental issues.

In environmental training it is necessary to overcome a number of cognitive, affective and logical learning difficulties. Many learners experience difficulty in mastering often complex scientific concepts, in accepting concepts that may go against their existing beliefs, and in understanding the complex web of causality in which environmental phenomena take place.

Research shows that learning difficulties are best overcome by using methods that are learner-centred and maintain close contact with the actual environment. It also suggests that training based on a few fundamental scientific concepts - structurant concepts - helps learners overcome their learning difficulties and provides a basis for future learning.

A territorial approach has proved an excellent method for environmental training. It encourages an understanding of the environmental, economic, social and cultural aspects of the territory or area, its resources, and the environmental impact of their use. It also helps learners to identify and implement solutions to environmental problems.

Over time, human communities have developed knowledge and beliefs about the environment that may facilitate or hinder learning. Environmental training should exploit those concepts and knowledge that tend to facilitate learning, while helping learners to abandon unscientific beliefs. Communities also have structures for conveying knowledge and skills to their members. By incorporating environmental training into these structures, a community can ensure the sustainability of its present and future activities.

Particularly challenging is the task of training uneducated people, such as illiterate farmers, illiterate women and informal sector workers. Job-based environmental training programmes, which use a community-based approach and simple and inexpensive training tools can change production practices, making production more sustainable, raising incomes and improving the quality of life.

The targets of environmental training differ. Different providers - schools, training institutions, enterprises, community organizations, trade unions, NGOs, the mass media - tend to have their own specific target audiences and have a comparative advantage in reaching that particular audience. Environmental training programmes organized by different providers can reinforce each other.

The training of trainers is a fundamental element of any environmental training programme. Environmental education and training are difficult tasks: they demand trainers who possess scientific and technical knowledge, work experience and training skills. Equipping trainers with this background is a major task of training programmes for trainers. Such training should convey to trainers the environmental concepts and tools that they need for integrating environmental issues into their training programmes. It should also develop their capacity to encourage students to take concrete action in favour of the environmental.

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Annex 1

Report on an informal Expert Meeting on Environmental Training: Policy and Practice ILO, Geneva, 20-21 May 1993

The above meeting was held to examine the draft final Report **Environmental Training: Policy and Practice** prepared by the Training Policy and Programme Development Branch of the ILO on the project Environmental education in vocational training. This project was financed by the Ministry of Education and Science of the Federal Republic of Germany. Participants in the Meeting were selected outside experts and ILO staff. A list of participants is attached to this report.

The participants agreed with the major findings of the draft Report. They considered it a useful contribution to the development of education and training for environmental protection and sustainable development. They suggested that the following observations of the Meeting be integrated into the Conclusions of the Report.

- Environment issues are crucial public issues. The task of environmental training must be assumed by public authorities with the participation of public and private educational and training institutions, enterprises, employers' and workers' organisations, non-governmental organisations and the general public.
- Putting into effect environmental protection and sustainable development policies may demand a reduction of polluting activities, with the subsequent loss of jobs. However, the introduction of sustainable development policies can be expected to generate new areas of economic activity and be a major source of new jobs. By means of environmental education and training, people can be prepared for engaging in these new activities.

- The end of the Cold War offers the opportunity to free massive human, financial and material resources tied in military-industrial complexes. These resources should be deployed in rehabilitating military sites and creating new, sustainable civilian employment opportunities. Preparing large numbers of people for new skills and jobs demands a large retraining effort.

- Environmental education and training must be sustained over time in order to ensure its effectiveness and impact. This can be done by integrating environmental knowledge, skills and ethics into the existing educational and training curricula. It is equally important to introduce these elements into systems of teachers training and community-based mechanisms for education and training.

- Sustainability of environmental education and training can be achieved by ensuring a steady supply of public financial resources, and by using other sources of finance, for example introducing fees, training-cum-production and by linking it with other entrepreneurial activities.

- Changes in individual and collective behaviour are a prerequisite for effective environmental protection and sustainable development. Environmental education and training should emphasize the development of environmental knowledge, skills and values and promote attitudinal and behavioural change. Emotional appeals are important tools for stimulating the necessary changes in attitude and behaviour towards the environment. These appeals can also stimulate people to overcome their learning obstacles and motivate them for future learning. As values develop early in life, environmental education should start in primary school age.

- An important mechanism for bringing home the environmental message is participation by the public in concrete environmental activities. For example, schools can organise recycling activities which act as a learning experience and stimulate behavioural change in the community.

- Many national and international education and training programmes in other key areas also emphasize behavioural change. These are, for example, population activities, prevention of AIDS and smoking and drug abuse, employment- and income-generating activities and programmes promoting health and safety in the work place. The experiences of these programmes can provide useful lessons for

environmental education and training. Environmental education and training programmes can also be integrated with some of these programmes, in particular those focusing on population activities, health and safety in the work place, promotion of public health and income-generating activities.

- Environmental protection and sustainable development require the mobilization of all human resources. However, developing countries face large difficulties in educating and training their people. Developing countries need to improve the quality of and access to education and training, and develop specific education and training activities in support of sustainable development.

- As resources are scarce, environmental education and training activities should endeavour to ensure the maximum possible effect by exploiting various multiplier mechanisms. These include the training of trainers and teachers who in their turn can train large numbers of people. The quality of trainers training is essential to the success of environmental education and training.

- Training materials are another multiplier. Training materials, adapted to local environments and culture, should be developed, evaluated, and diffused widely. The development of local capacity to produce such materials is essential. International organisations can stimulate local capacity building by preparing and diffusing basic models and core training material that can be adapted to local needs.

- Decision-makers often lack awareness about the environment and environmental implications of their decisions. A central issue is therefore the training of decision-makers in government, enterprises, community organisations etc. Such training should be given in short sessions that focus on priority problem areas.

- Enterprises often see environmental issues as negative issues. Corrective policies are costly. Preventive policies, although costly in the short term, can in the long run generate high economic returns. Environmental protection should be approached as an opportunity to improve production practices, use resources better, create economic and employment opportunities and improve the quality of life. By using Total Quality Environmental Management (TQEM) techniques, enterprises can reduce negative environmental impacts while

improving product quality, reducing costs and increasing economic return.

- Young people are an important target group for environmental education and training efforts. They can educate their parents and, as prospective workers, they can ensure that the environment will become sustainable. In many countries, students drop out of school early. The opportunity to educate them should be seized by introducing environmental education and training during the first years of primary schooling.
- Networks of environmental education and training institutions and practitioners can improve the activities of the participants in these networks. The exchange of educational experiences can be facilitated by using various media, such as journals, newsletters, etc. and electronic communication methods.
- Various international, governmental and non-governmental organisations are engaged in environmental education and training in their particular areas of competency. In undertaking these activities, effective collaboration between them can ensure synergy, reduce costs and avoid overlapping.
- International organisations should integrate environmental considerations into all their projects and programmes.

The participants suggested that the Report be edited as a book and translated into various languages, such as French, German, Spanish, Russian and Polish in order to ensure the widest possible diffusion of its findings. It could also be distributed as a working document. They also recommended that an executive summary be prepared. The Report should be updated regularly as it offers an excellent basis for developing further environmental training activities focusing on particular sectors and target groups.

ENVIRONMENTAL TRAINING

POLICY AND PRACTICE FOR SUSTAINABLE DEVELOPMENT

Progress towards a sustainable pattern of development will demand significant changes in economic and social activities in order to eliminate their adverse impact on the environment. Production technology, managerial and work practices and people's attitudes and behaviour need to change in order to make them compatible with a healthy and "sustainable" environment. Environmental training is a major tool in bringing these changes about.

This book, written for policy makers and individuals and institutions who plan and organize environmental training programmes, raises some major issues of environmental training policy and practice and illustrates them with the help of concrete examples. They include analysing the environmental labour market and identifying the environmental skills and competencies that will contribute towards making jobs and the exercise of professional activity environmentally sustainable. All people need them in their daily activities. The book therefore also raises some issues of environmental education which aims to create responsible environmental attitudes and behaviour, a new environmental ethic. The book identifies the most common difficulties in learning and applying environmental concepts and tools and analyses out the institutional strategies and training methods that are most conducive to overcome them.

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